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February 1991

1991 Educational Committee Guide to Coatings Courses, Symposia, and Seminars.

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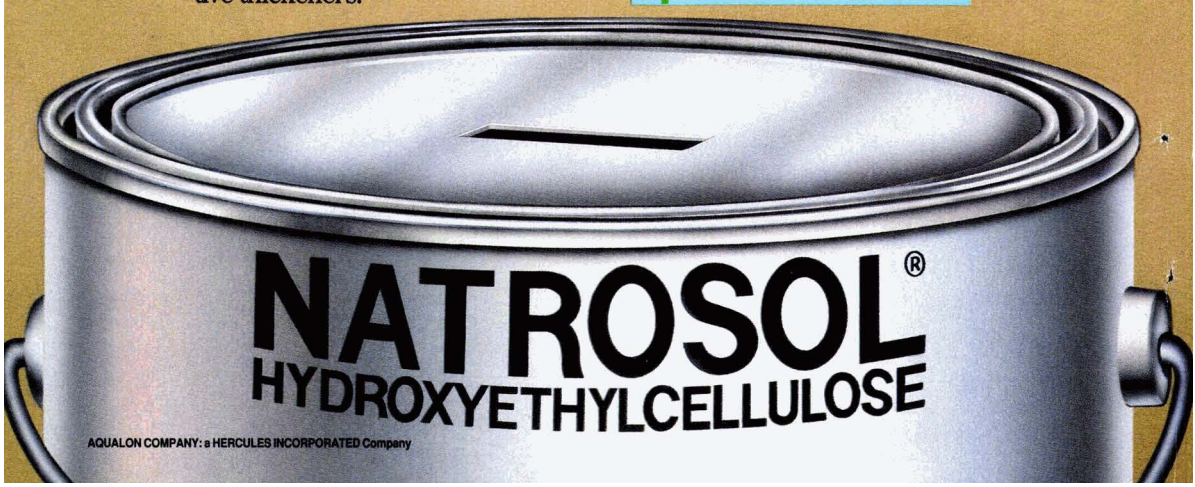

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JOURNAL OF COATINGS TECHNOLOGY

GUIDE FOR AUTHORS

GENERAL

The JOURNAL OF COATINGS TECHNOLOGY is published monthly by the Federation of Societies for Coatings Technology for its membership of approximately 7,300 in 26 Constituent Societies in the United States, Canada, Great Britain, and Mexico. The JOURNAL is devoted to the advancement of knowledge in the science and technology of surface coatings, the materials comprising such coatings, and their use and performance.

The Editors invite submission of original research papers, review papers, and papers under the special headings *Open Forum* and *Back to Basics*, as well as *Letters to the Editor*. All manuscripts will be assumed to be previously unpublished writing of the authors, not under consideration for publication elsewhere. When review papers contain tables or graphs from copyrighted articles, the authors will be required to obtain permission for use from the copyright holders. When the organization with which the authors are affiliated requires clearance of publications, authors are expected to obtain such clearance before submission of the manuscript. Papers presented to associations other than the Federation must be released by written communication before they can be considered for publication in the JOURNAL OF COATINGS TECHNOLOGY. Authors are obligated to reveal any exceptions to these conditions at the time a manuscript is submitted.

The JOURNAL OF COATINGS TECHNOLOGY has first right to the publication of papers presented at the Annual Meeting of the Federation and at local regional meetings or symposia of the Constituent Societies.

Papers in which proprietary products or processes are promoted for commercial purposes are specifically nonacceptable for publication.

SUBMISSION OF MANUSCRIPTS...

...for the Journal

Four complete copies should be sent to the Editor, JOURNAL OF COATINGS TECHNOLOGY, 492 Norristown Rd., Blue Bell, PA 19422-2350. The cover letter should address copyright, clearance, and release issues discussed above and should specify paper category: *Original Research, Reviews, Open Forum*, or *Back to Basics*.

Letters to the Editor: The JOURNAL will consider for publication all correspondence relevant to the coatings industry and to the contents of the JOURNAL. When a letter concerns an article appearing in the JOURNAL, the original author is usually given an opportunity to reply.

. . . by Constituent Societies For Annual Meeting Presentation

Ten complete copies of the manuscript are required for committee review. The set of copies should be addressed to the Editor at the address listed previously.

. . . for Roon Foundation Award Competition

Ten complete copies of the manuscript are required, and should be submitted to the Chairman of the 1991 Roon Awards Committee, George R. Pilcher, Akzo Coatings, Inc., P.O. Box 147, Columbus, OH 43216. (For complete details, see "Roon Awards" section of the JOURNAL in January 1991 issue.)

MANUSCRIPT PREPARATION

In general, authors are advised to use the "Handbook for Authors" published by the American Chemical Society as a guide to the preparation of manuscripts (ACS, 1155 Sixteenth St., Washington, D.C. 20036). Another excellent reference work is "How to Write and Publish a Scientific Paper," by Robert A. Day (ISI Press, 3501 Market St., University City Science Center, Philadelphia, PA 19104).

Authors are encouraged to consider submissions in several categories and to prepare their manuscripts accordingly. The categories are:

Original Research Papers: The main technical content of the JOURNAL OF COATINGS TECHNOLOGY will continue to be original research papers. Editors support the trend in scientific writing to a direct, less formal style that permits limited use of personal pronouns to avoid repetitious or awkward use of passive voice.

Review Papers: Papers that organize and compare data from numerous sources to provide new insights and unified concepts are solicited. Reviews that show how advances from other fields can beneficially be applied to coatings are also desired. Reviews that consist mainly of computer searches with little attempt to integrate or critically evaluate are not solicited.

Open Forum: Topics for this category may be nontechnical in nature, dealing with any aspect of the coatings industry. The subject may be approached informally. Editors encourage submission of manuscripts that constructively address industry problems and their solutions.

Back to Basics: Papers that provide useful guides to Federation members in carrying out their work are solicited. Topics in this category are technical but focus on the "how to" of coatings technology. Useful calculations for coatings formulation and procedures that make a paint test more reproducible are examples of suitable topics. Process and production topics, i.e., paint manufacture, will also be reviewed in the *Back to Basics* category.

If a submitted paper consists of the text of a presentation made previously to a monthly or special meeting of a Society for Coatings Technology, or to another technical group, the name of the organization and the date of the presentation should be given. If someone other than the author of the paper made the presentation, this information, too, should be noted. Papers originally composed for oral presentation will have to be revised or rewritten by the author to conform to the style described in this guide.

Manuscripts should be typed with double spacing on one side of $8\frac{1}{2}$ x 11 inch (22 x 28 cm) paper, with at least one-inch (2.5 cm) margins on all four sides. All paragraphs should be indented five spaces, and all pages should be numbered at the top center, or upper right corner.

Title

The title should be as brief and informative as possible. Selection of titles that are key word-indexable is a helpful and recommended practice.

Authors' Biographies and Photographs

Give complete names, company or institutional affiliations, and brief biographical sketches of all authors. If available, submit a 5 x 7 inch (13 x 18 cm) black-and-white photograph with glossy or smooth high sheen surface, for each author. See later section on photographs for further details.

Abstracts

A 75 -100 word abstract must be part of the manuscript, and should be a concise description of the key findings or teachings of the work described in the paper. The abstract should not repeat the title or include reference numbers, nor should it duplicate the Conclusion or Summary.

Text

Main headings and sub-headings should be used to improve readability, and to break up typographical monotony. The text should *not* be presented as an alphanumeric outline.

The main headings usually should be INTRODUCTION, EXPERIMENTAL, RESULTS AND DISCUSSION, and SUMMARY or CONCLUSIONS. Sub-headings will be specific to the subject.

Only as much review as is necessary should be given to provide an introduction to the subject; the main burden for extensive background should be placed on the list of references.

Standard scientific and technical terminology should be used to convey clear and unambiguous meaning, but the use of technical jargon or slang should be avoided. Authors should bear in mind that the JOURNAL has an international audience, for many of whom English is a second, not native, language. Use of regional idioms or colloquialisms should be avoided. The use of obscure abbreviations is also discouraged. When appropriate, abbreviations should be made in parenthesis immediately following first mention of the term in the text, and then used alone whenever necessary.

Recent issues of the JOURNAL should be consulted for desired style and technical level.

Metric System

Metric system units should be used wherever applicable with the equivalent English units shown afterwords in parentheses. The ASTM Metric Practice Guide, E 380-72 (American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103) is a convenient reference.

Tables, Graphs, and Drawings

Tables, rather than descriptive text, should be used only when they are genuinely helpful. They should be proportioned in accordance with the height and width limitations of the JOURNAL's pages. Each table should be typed on a separate sheet, rather than included in the text, and appended to the manuscript. Each table should be numbered and have a descriptive caption. Tables should be referenced in the text (e.g., "See *Table* 1").

In numerical data in tables, numbers less than one should have a zero before the decimal point.

Graphs should be on good quality white or nonphotographic blue-lined $8\frac{1}{2}$ x 11 inch paper. Each graph should be drawn on a separate sheet, numbered, and the captions listed on a *copy* of the original graph. Graph captions and legends should also be typed on a separate sheet from original for typesetting.

Drawings should conform to the guidelines given for Graphs and should be proportioned to fit the height-to-width ratio of the JOURNAL's pages and columns.

Photographs

All photographs should be sharp, clear, black-and-white prints no larger than 8 x 10 inches in size. Photos should be clearly labeled on the reverse side, taking care not to mar the image.

Color prints and slides are unacceptable.

When illustrations are secured from an outside source, the source must be identified and the Editor assured that permission to reprint has been granted.

Nomenclature

Whenever possible, generic names should be used in preference to trade names. When trade names must be used to avoid ambiguity, and the name is a registered trademark, the symbol R, in a circle or parentheses, should be given immediately following, and the manufacturer listed as a footnote. In general, trade names should be used only in footnotes or in an appendix, rather than in the text.

If special nomenclature is used, include a nomenclature table giving definitions and dimensions for all terms.

Nomenclature of chemical compounds should conform to the style of *Chemical Abstracts* and the IUPAC rules. For oligomeric or polymeric materials, characteristics such as molecular weight, polydispersity, functional group content, etc. should be provided.

Equations

Equations must be typed, or written clearly, with equations numbered sequentially in parentheses to the right. If Greek letters are used, write out their names in the manuscript margin at the first point of use. Place superscripts[a] and subscripts$_b$ accurately. Avoid the use of superscripts in a manner that can lead to their interpretation as exponents.

Summary

The paper should be concluded with a summary which is intelligible without reference to the main text. The summary may be more complete than the abstract, listing conclusions drawn from the text. A well written summary can serve to inspire the busy reader to turn back to the paper, to read it thoroughly.

Acknowledgment

If used, it should follow the summary.

References

These should be listed in the numerical order in which they are cited in the text, and should be placed at the end of the manuscript. Names of authors may or may not be shown in the text with reference numbers. If possible, include titles of articles referenced in the literature. The following are examples of acceptable reference citations for periodicals, [1,2,3] books, [4] and patents.[5]

(1) Pascal, R.H. and Reig, F.L., "Pigment Colors and Surfactant Selection," *Official* DIGEST, *36*, No. 475 (Part 1), 839 (1964).

(2) Davidson, H.R., "Use and Misuse of Computers in Color Control," JOURNAL OF COATINGS TECHNOLOGY, *54*, No. 691, 55 (1982).

(3) Stephen, H.G., "Hydrogen Bonding—Key to Dispersion?," *J. Oil & Colour Chemists' Assoc.*, *65*, No. 5, 191 (1982).

(4) Patton, T. (Ed.), "Pigment Handbook," Vol. 1, John Wiley & Sons, Inc., New York, 1973.

(5) Henderson, W.A. Jr. and Singh, B. (to American Cyanamid Co.), U.S. Patent 4,361,518 (Nov. 30, 1982).

OTHER INFORMATION

Galley proofs will be sent to the author for checking about six weeks prior to publication.

Offprints may be purchased in quantities of 100 or more. Authors will receive price quotations. Each author will receive a complimentary copy of the JOURNAL issue in which his or her paper was published.

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JOURNAL OF COATINGS TECHNOLOGY

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The Federation of Societies for Coatings Technology assumes no responsibility for the opinions by authors in this publication.

Comment

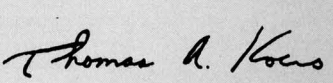
Nourishing the Educational Tree at the Grassroots

Featured in this issue is the Educational Committee's "Guide to Coatings Courses, Symposia, and Seminars," the annual compilation of offerings available to those seeking instruction and updating in coatings-related technology.

It's interesting to note both the quantity and variety of listings. Noteworthy, too, is the number of events sponsored by our Constituent Societies. For many of these, Society members serve as advisors, instructors, or guest lecturers, and have done so for many years.

Promoting and supporting educational activities has, of course, long been a priority consideration for the Societies, and these programs typify their ongoing efforts in this regard. And their efforts are underscored by the funding they provide in support of education. As reported on page 12, Society allocations for scholarships and related educational activities in 1989 totaled $54,000—a significant "grassroots" contribution to the industry's educational well-being.

People are our most important asset, and the Constituent Societies, through their continuing dedicated support of educational activities, are helping nourish the professional growth of coatings personnel. Their efforts should be duly recognized and appreciated.



Thomas A. Kocis
Contributing Editor

Abstracts of Papers in This Issue

SOLVENT AND CATALYST EFFECTS IN THE REACTION OF DICYCLOHEXYLMETHANE DIISOCYANATE WITH ALCOHOLS AND WATER—S.D. Seneker and T.A. Potter

Journal of Coatings Technology, 63, No. 793, 19 (Feb. 1991)

The following catalysts, dimethyl- and dibutyl-tin dichloride, and dimethyl- and dibutyl-tin dilaurate, are compared to determine the effect of the alkyl group and labile ligand on the reaction kinetics of 4,4′-dicyclohexylmethane diisocyanate (reduced MDI, rMDI) with 1000 MW polytetramethylene glycol (PTMG-1000). The less sterically hindered dimethyl-tin catalysts were more active on a mole for mole basis than the dibutyl-tin counterparts. We also found that the dialkyltin dichloride catalysts have significantly lower activation energies than the dilaurate catalysts.

The kinetic results from the rMDI/PTMG-1000 reaction are compared with the model reaction of rMDI with n-butanol using two different solvents: N-methyl-2-pyrrolidone (NMP) and triethylene glycol dimethyl ether (triglyme). Triglyme, being a polyether, was a good model solvent for simulating the reaction kinetics of rMDI with polytetramethylene glycol.

We also determined the effect of catalyst structure on the reaction kinetics of rMDI with water and found that there was no significant alkyl group or labile ligand effect.

From this information, the apparent selectivity of rMDI towards n-butanol and water was determined by a simple ratio of the reaction rates. In general, the dimethyl-tin catalysts resulted in a higher selectivity towards n-butanol than the dibutyl-tin catalysts. The temperature had no effect on the apparent selectivity with the tin dichloride catalysts; however, the selectivity increased with increasing temperature with the dilaurate catalysts. This information may be useful in formulating coatings that are less sensitive to side reactions with water, yet have a reasonable cure rate.

DETERMINATION OF THE PROTECTIVE PROPERTIES OF CATIONIC PRIMERS WITH A.C. IMPEDANCE MEASUREMENTS—V.B. Mišković-Stanković, D.M. Dražić, and N.M. Aćamović

Journal of Coatings Technology, 63, No. 793, 25 (Feb. 1991)

A.C. impedance measurements were carried out on organic coatings of different thicknesses electrodeposited on different substrates: steel, phosphatized steel, and phosphatized zinc electroplated steel. The values of the pore resistance, capacitance, and relative permittivity of protective primers show the effects of the type of substrate and film thickness on corrosive behavior. The coatings formed on steel and phosphatized steel have greater values of pore resistance and smaller values of capacitance and relative permittivity than coatings formed on phosphatized zinc electroplated steel. An increase in the film thickness increases the pore resistance and decreases the capacitance which points to better protective properties and greater stability. At initial times while the coatings keep their protective properties against the corrosive agent (3% NaCl), relative permittivity was independent of film thickness. As time progresses, however, the increase in film thickness decreases the relative permittivity of the coating, indicating the deterioration of the protective film.

ZINC REACTIVITY IN ZINC-RICH COATINGS CO-PIGMENTED WITH DI-IRON PHOSPHIDE—S. Feliu, Jr. et al.

Journal of Coatings Technology, 63, No. 793, 31 (Feb. 1991)

The attack of zinc particles in zinc-rich coatings is relatively insensitive to the quantity of di-iron phosphide and the type of vehicle (ethyl silicate or epoxy-polyamide) in the paint, and to the composition of the corrosive medium (various saline solutions). This behavior is explained in terms of diffusion control through the film of zinc corrosion products around the zinc particles. The effect of these corrosion products on the coating's electrochemical activity is discussed.

APPLICATIONS OF PHOTOINITIATED CATIONIC POLYMERIZATION IN COATINGS—J.V. Crivello

Journal of Coatings Technology, 63, No. 793, 35 (Feb. 1991)

The recent development of diaryliodonium, triarylsulfonium, and ferrocenium salts as highly efficient photoinitiators for cationic polymerization has generated an entire new class of fast polymerizations which are uniquely suited for use in coating applications. This paper reviews the chemistry of the fundamental processes involved in the photolysis of the photoinitiators and mechanism of initiation of cationic polymerization. Structural modifications of the basic photoinitiator structures, which result in increased efficiency of polymerization, have been carried out. Systems based on epoxy and vinyl ether monomers were developed which are capable of generating coatings with a wide range of desirable mechanical and chemical properties.

FSCT-Sponsored Seminars on SPC for Coatings To Be Presented during March in Chicago

The application of Statistical Process Control (SPC) to coatings manufacture will be discussed in a series of introductory and intermediate-level seminars sponsored by the Federation.

To be held during March in Chicago, at the O'Hare Marriott, under the auspices of the Federation's Professional Development Committee, the seminars are a repeat of those held previously, along with a new one-day presentation on implementing the SPC components of Total Quality Management. Dr. Peter J. Hunt, President of Productivity Management Consultants, Clearwater, FL, will again conduct the seminars.

Now in their fifth year, the seminars are offered in recognition of the spreading implementation of SPC to achieve consistency, reduce variation, and improve quality. They are designed specifically to introduce Statistical Process Control methods to personnel working in coatings manufacturing and related areas (e.g., chemicals, pigments) which employ a batch process.

The introductory (Level I) two-day seminar will be held March 11-12. Discussions emphasize the application of Dr. Edwards Deming's concepts which apply statistics to production samples to reduce variation and minimize waste, and focus on identifying appropriate product and machine variables to measure, plotting and interpreting SPC control charts, evaluating process capability, and implementing an SPC system.

The new one-day seminar, "How to Implement Total Quality Management," will be held on March 13 and again on March 18. This presentation focuses on the value of a broad-based quality effort — one which encompasses not only production, but all aspects of providing a product and/or service, to achieve a Total Quality Management (TQM) system. Programming is designed to provide participants with the ability to identify and understand each component of a TQM system, understand how SPC is a tool for implementing some components of TQM, and develop a plan for implementing a TQM system in their company and execute that plan. Although SPC activities make up only a portion of the components in TQM, they are the more difficult to implement and are given special emphasis.

The intermediate (Level II) three-day seminar, to be held March 19-21, stresses the practical application of statistical techniques to respond to manufacturing, research, and management concerns to improve first run capability. Emphasis is on statistical techniques to answer management questions, such as reliability of the test equipment, statistical differences between procedures, and use of correlated variables to control and/or predict outcomes. Registrants should have a basic understanding of Statistical Process Control (attendance at the Level I seminar or equivalent) and a working knowledge of basic algebra.

The format for each seminar is practical rather than theoretical, offering a "hands-on" understanding to insure proper implementation.

Registration fees are: Introductory (Level I)—$250 for FSCT members, $350 for non-members; Implementing TQM—$125 for FSCT members, $175 for non-members; Intermediate (Level II)—$350 for FSCT members, $450 for non-members.

To obtain complete program information and registration/housing forms, contact Federation of Societies for Coatings Technology, 492 Norristown Road, Blue Bell, PA 19422-2350. Phone: (215) 940-0777; FAX: (215) 940-0292.

New One-Day Seminar on Implementing TQM Added to SPC Series for 1991

Nearly a thousand members of the coatings and related industries have attended the Federation's Introductory (Level I) and Intermediate (Level II) seminars on Statistical Process Control presented by Dr. Peter J. Hunt during the last several years. In responses to questionnaires, seminar attendees have expressed extremely favorable comments on the quality and value of the presentations—to the phenomenal extent of well over 90% of the replies.

Now, in response to requests from many of the attendees, Dr. Hunt has developed a one-day, stand alone Total Quality Management seminar to assist those charged with implementing a TQM system, which will be presented on March 13 and again on March 18 as part of the 1991 SPC series.

One by one, the individual components of TQM will be explained and instructions given for implementing each, with special emphasis on SPC.

The new seminar is designed ideally to build on the knowledge acquired in the Level I presentation, and will be offered immediately following the introductory seminar, scheduled for March 11-12. Of course, those who have already attended a Level I presentation may enroll just for the implementation seminar, which will also be held on the day preceding the Level II seminar, scheduled for March 19-21—a sequence which will be logically compatible with the Level II subject matter.

The seminar is particularly well-suited for Quality Improvement/SPC Coordinators, upper-level managers who seek an overview or need to be "sold" on TQM, and all managers who must participate in some aspect of TQM implementation.

The application of Statistical Process Control and Total Quality Management systems is unquestionably the direction in which all industries serving quality-demanding consumers will have to go for assurance of uniform product quality, and for optimizing profitability by producing the right product the first time, every time. The Federation is pleased and proud to be able to offer the services of so authoritative and excellent a lecturer as Dr. Hunt in seminars that represent great value in comparison with courses available from commercial sources.

"Formulating for the Future" to Be Focus of Discussions At FSCT Spring Seminar in Philadelphia, May 13-14

"Formulating for the Future" is the theme of the 1991 Federation Spring Seminar, to be held May 13-14 at the Sheraton Society Hill, Philadelphia, PA.

Programming for the 1-1/2 day event will emphasize developments in waterborne resin and additive technology, representing recent and significant technical advances, which are available to the coatings formulator, or will be in the near future.

Program

The Keynote Address will be presented by Donald Smith, Vice President-Regulatory Affairs, Pratt & Lambert, Inc., Buffalo, NY.

Other program speakers and their topics are:

"Air Monitoring of Volatile Organic Materials in Latex Architectural Coatings"—Walter Gozdan, Section Manager, Research Laboratories, Rohm and Haas Company, Spring House, PA.

"Development of an Effective 'Non-Toxic' Corrosion-Inhibitive Pigment"—Michael Beland, Senior Chemist, Halox Pigments, Hammond, IN.

"A Combined Corrosion/Weathering Accelerated Test for Coatings for Corrosion Control: Correlating Field and Laboratory Exposures"—Dr. Brian S. Skerry, Consumer Division Technical Center, The Sherwin-Williams Company, Cleveland, OH.

"Water-Based Two-Component Polyurethane Coatings for High Performance Applications at Very Low VOC"—Richard Hergenrother, Senior Development Representative, Maintenance & Construction Coatings, Coatings Division, Mobay Corporation, Pittsburgh, PA.

"Fluidized Polymer Suspensions (FPS): Cellulosic Thickeners in Liquid Form"—C.W. Vanderslice, Research Center, Aqualon Company, Wilmington, DE.

"Waterborne Nitrocellulose Lacquers for Wood Coatings with Lower VOC"—Charles M. Winchester, Hercules, Incorporated, Wilmington, DE.

"A New Class of Associative Thickeners for the 90s"—Greg Shay, UCAR Emulsion Systems, Union Carbide Chemicals and Plastics Company, Inc., Alsip, IL.

"Waterborne Coatings/Resins That Penetrate into Wood Surfaces"—Al Heitkamp, Senior Research Scientist, Cargill, Incorporated, Minneapolis, MN.

"Propylene Glycol Ethers as Coalescing Aids in Waterborne Acrylic Emulsions: Formulating for the 1990s"—James Bodwell, Principal Scientist, ARCO Chemical Company, Newtown Square, PA.

"Peroxide Curable Coatings—Isocyanate and Formaldehyde-Free Low VOC, Two-Component Systems"—Dr. Del Eslinger, Freeman Chemical Corporation, Port Washington, WI.

"Waterborne Silicone-Based Coatings for High Temperature Service"—Jay W. Adams, Technical Service Manager, Tego Chemie Service USA, Hopewell, VA.

Several open forum sessions will be featured, at which speakers will assemble as a panel to respond to questions from attendees.

Programming has been arranged by a committee of members of the Philadelphia Society for Coatings Technology, under the direction of Chairman Orville E. Brown, Corporate Technical Director, M.A. Bruder & Sons, Inc. Serving on the committee are Lawrence J. Kelly, Eastech Chemical Company, and Peter C. Kuzma, V.I.P. Products Corporation.

Registration

To register, fill out the form on the opposite page and return to Federation headquarters.

Registration fee is $160 for FSCT members, and $190 for non-members. (Payment must be made in U.S. funds, payable on U.S. banks.)

The registration fee includes continental breakfast, luncheon, coffee breaks, and copies of papers presented, as well as bus transportation to Philadelphia International Airport at conclusion of the seminar. *Please note reference to bus on registration form and check appropriate box.*

Housing

Requests for seminar room accommodations at the Sheraton Society Hill Hotel must be made on the accompanying housing form and returned to FSCT headquarters.

Seminar room rate is $118, single, and $138, double (per night). Note that reservations must be received no later than April 12 to assure availability and rates.

The Sheraton Society Hill Hotel is located in downtown Philadelphia, in the heart of the historic neighborhood, just steps away from Independence Hall, the Liberty Bell, and Independence National Historic Park.

Ground transportation to and from Philadelphia International Airport is available on a regular schedule.

Air Transportation

USAir, in cooperation with the Federation, is offering special discounted airline fares which afford a 35% minimum savings off round trip, undiscounted day coach fares for travel to the FSCT Spring Week on the airline's domestic systems.

To take advantage of this exclusive low fare, you must travel solely on USAir round trip. Telephone the following numbers for reservations, giving the FSCT file number, Gold File #654579: for United States, Bahamas, and San Juan (800) 334-8644; for Canada (800) 428-4322, ext. 7702.

If you use a travel agent, have reservations placed through the toll-free numbers to obtain the same fare advantages. USAir has a variety of other promotional fares, some of which may represent even greater savings. When making reservations, request the best discount applicable to your itinerary.

To obtain complete program information, contact Federation of Societies for Coatings Technology, 492 Norristown Road, Blue Bell, PA 19422-2350 (Telephone: 215/940-0777; FAX: 215/940-0292).

$1000 Donation for FSCT Scholarship Fund Generated by Troy Corp.'s Capitol Fun Run

Troy Corporation's Fourth Annual Paint Show 5000 Fun and Fitness Run in Washington, D.C., drew 200 paint industry runners. All entry fees were again donated to the Joseph A. Vasta Memorial Scholarship Fund of the Federation of Societies for Coatings Technology. Entry fees from the turnout generated a $1000 contribution to the scholarship fund. The event has generated $3250 for the Federtion's Joseph A. Vasta Scholarship Fund to date.

The run was hosted by the Potomac Valley Seniors Running Club. Dr. Matthew Guidry, Director of Comunity Services for the President's Council of Physical Fitness was the honorary starter. The event was held at the Great Mall with the permission of the National Parks Services.

Plans are already underway for the 1991 Paint Show 5000 to be held in Toronto in November.

"FORMULATING FOR THE FUTURE" SEMINAR REGISTRATION FORM

May 13-14, 1991 Sheraton Society Hill, Philadelphia, PA

Registration fees: $160 (FSCT members); $190 (non-members)

Check must accompany registration form. Make checks payable to Federation of Societies for Coatings Technology. (Payment must be made in U.S. funds payable on U.S. banks.)

NICKNAME (For Registration Badge) _____

FULL NAME _____

JOB TITLE _____

COMPANY _____ PHONE _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Name of Federation Society
Of Which You Are a Member _____

I will ☐ will not ☐ use the Federation bus to the Philadelphia Airport at conclusion of seminar.

Return form and check to: FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY
492 Norristown Road
Blue Bell, PA 19422-2350

IF YOU REQUIRE HOUSING AT SHERATON SOCIETY HILL HOTEL COMPLETE FORM BELOW

HOUSING FORM
Sheraton Society Hill Hotel

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Arrival Date _____ ☐ Before 6 pm ☐ Late* Departure Date _____

Please reserve: Single _____ $118.00 (per night)

Double/Twin _____ $138.00 (per night)

*Reservations will be held until 6:00 pm. If arrival is after 6:00 pm, hotel requires deposit for one night's lodging to guarantee availability. Make check payable to "Sheraton Society Hill Hotel."

Note: Reservations must be made no later than April 12 to guarantee availability and rates.

Return this form to: FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY
492 Norristown Road, Blue Bell, PA 19422-2350

Constituent Societies Report on 1989 Funding To Support Educational Programs; Total Tops $54,000

For years, the Federation has been supporting scholarship programs with annual appropriations; currently, it is contributing funds to such programs in six universities. This support is duly recorded in the reports of the semi-annual meetings of the Board of Directors that are published in the JOURNAL OF COATINGS TECHNOLOGY. Support for special projects, such as the Federation's recent $20,000 contribution (supplemented by one for $5,000 from the Coatings Industry Education Fund) to help start the curriculum in polymer and coatings science at the California Polytechnic State University (Cal Poly) at San Luis Obispo, are similarly reported in JCT and in the trade press, where the reports have high visibility.

After hearing the reports of the Society representatives on the Federation Educational Committee at one meeting after another about the financial expenditures for educational purposes made by the individual Societies, it occurred to the Educational Steering Committee that this generous support of education by the *individual* Societies deserved more recognition.

Therefore, in mid-1990, the Steering Committee circulated a questionnaire to the Presidents and Educational chairs of the Societies requesting information on the nature and extent of each Society's appropriations for educational purposes from their own budgets. We have received responses from 24 of the 26 Societies, and were highly gratified to learn that appropriations totaled over $54,000, which exceeds the $43,000 appropriated for scholarships by the Federation itself in 1990. It should be noted that the Federation's scholarships appropriation is supplemented by its subsidies for the expenses of the Educational and Steering Committee meetings.

A combined annual expenditure approximating $100,000 for education is a very respectable figure indeed for a voluntary organization of about 7,000 members.

Accompanying our questionnaire was an invitation to those responding to estimate the total educational appropriations by the Societies. We offered a gift of a copy of the Federation's "Paint/Coatings Dictionary" to each of the two persons whose estimates were closest to the actual total. Closest estimate was by Peter Duncker, of the Toronto Society, whose estimate of $52,000 was very nearly correct. Runner-up was Art McDermott, of the Houston Society, who estimated the total at $50,000.

We believe that what the individual Societies are doing in their own regions to promote education in our industry reflects both high public spirit and enlightened self-interest. They deserve this recognition and appreciation.

—The Educational Steering Committee

SURVEY OF SOCIETY FUNDING FOR EDUCATIONAL PROGRAMS—1989 (In U.S. Dollars)

Society	Type of Program	Amount of Funding
Baltimore	Scholarship	$ 2,000
Chicago	Scholarship	1,000
Cleveland	Science Fair	450
Detroit	University Research Grant	4,000
	High School Science Teachers/ Workshop	250
	Science Fair	25
Golden Gate	Scholarship	3,000
Houston	Scholarship	1,500
Kansas City	Scholarship	500
	Science Fair	225
Los Angeles	Scholarship	18,450*
Montreal	Science Fair	125
New England	Scholarship	1,500
	Student Paper Awards	1,000
New York	Scholarship	1,000
Northwestern	Scholarship	4,000
Pacific Northwest	Scholarship	2,000
Piedmont	Scholarship	1,000
Pittsburgh	Science Fair	300
Rocky Mountain	Cal Poly Contribution	1,000
St. Louis	Scholarship	1,000
Southern	Scholarship	5,500
	Student Paper Award	1,000
	Training Seminar	500
Toronto	Coatings Courses	1,700
Western New York	Scholarship	800
	Science Fair	250
	TOTAL	$54,075

* Includes proceeds from 1989 Western Coatings Societies' Symposium and Show.

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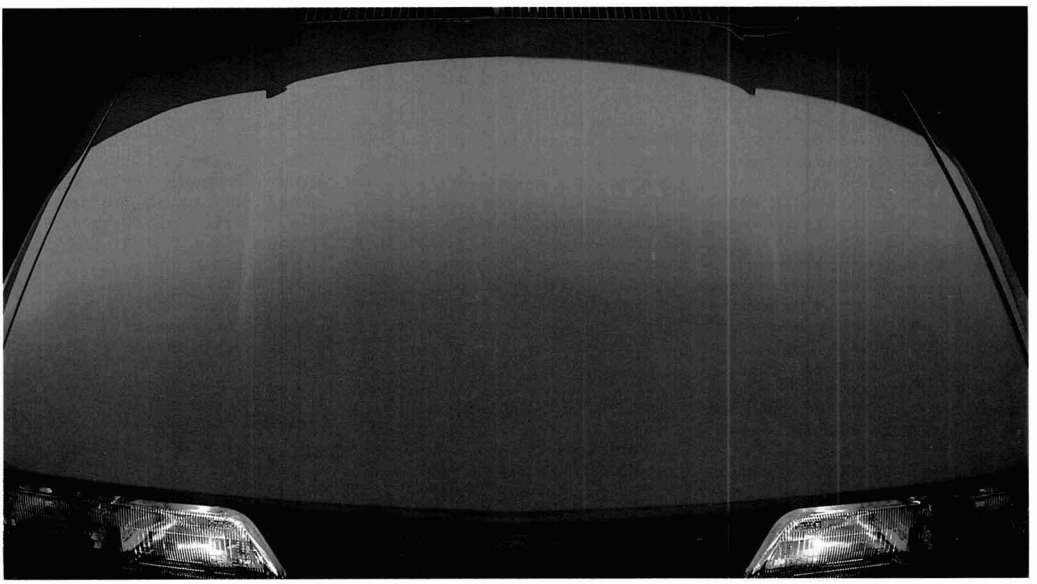
WE SEE IT AS A START.



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We must also make sure that we've got the production capacity to meet your needs. So we've invested $100 million in the U.S. in the last five years. And we plan to spend $300 million more over the next five years.

And we must make sure there are no production or formulation problems with our materials. So our technical service representatives work with you, often on-site, to help you analyze your problems and make recommendations. They speak your language because they've worked in the coatings industry themselves.

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What it all adds up to is this: If you want to protect your finishes, CIBA-GEIGY is the place to start.

For more information, call toll-free, 800-431-1900 (in New York, 914-347-4700), or write to: CIBA-GEIGY Corporation, Additives Division, Seven Skyline Drive, Hawthorne, NY 10532.

CIBA–GEIGY

Wisconsin PCA Wins 1990 Clark Award; Three Locals Receive Honorable Mention

During the National Paint & Coatings Association's annual meeting, held in Washington, D.C., in October, the Wisconsin Paint & Coatings Association was presented with its second consecutive Allen W. Clark award to recognize an exceptional community service program. The Wisconsin local won the 1990 Clark Award for maintaining a Picture It Painted program that produced eight projects and generated ongoing media attention throughout the year.

WPCA began its community improvement campaign by painting the interior of a YWCA facility that essentially serves as a child care center. With the help of the YWCA staff, members of the Wisconsin paint industry completed the project in a single day.

The group's second project brought an interior and exterior facelift to an abandoned building to be used as a group home for chronically, mentally ill homeless people in Milwaukee. The Wisconsin Chemical Group and local contractors joined WPCA in sponsoring the group home renovation project. Through a separate project, the Wisconsin paint industry also helped to refurbish a transitional housing facility.

WPCA's 1990 community improvement campaign included the renovation of two Milwaukee schools. In addition, the Wisconsin paint group continued to work with the city of Milwaukee by sponsoring two campaigns to erase graffiti from Milwaukee neighborhoods and participating in the city's paint recycling program.

The 1990 Clark Award competition also brought honorable mentions to the Chicago, Detroit, and Kansas City Paint & Coatings Associations. These three locals were recognized during the annual meeting for outstanding projects and publicity efforts.

The Chicago paint industry earned an honorable mention for producing a multiple-project PIP campaign. CPCA provided paint donations to a number of organizations which resulted in efforts to revitalize low and moderate income areas, to renew community homes, and to beautify commercial and residential buildings, as well as to renovate a facility for homeless boys.

CPCA also undertook a citywide anti-graffiti campaign to help dissuade the banning of aerosol paint cans.

In Detroit, the local paint industry was honored for its co-sponsorship of a one-day "paint-blitz" in the city's Ravendale community and the interior facelift of the neighborhood elementary school. DPCA donated more than 800 gallons of paint that helped renew the neighborhood.

An honorable mention was awarded to the Kansas City Paint & Coatings Association for undertaking two successful projects that earned tremendous exposure for the local paint industry. Its first effort was the second phase of an ongoing commitment to support the expansion of the city's public zoo. With volunteer labor provided by local IBM employees, the Kansas City local brought a fresh coat of paint to several of the zoo's old and newly-constructed structures.

In its second project, the KCPCA joined forces with LIFE (Let's Improve Our Future Environment), a youth environmental organization, to sponsor a citywide late paint recycling program. The two groups organized a paint collection day, resulting in the recycling of more than 400 gallons of paint which were redistributed to the Operation Brightside community group for neighborhood improvement.

A total of 50 projects were undertaken during the 1990 Picture It Painted season.

National Paint & Coatings Assoc. Names New Officers

New NPCA officers were elected and installed at the association's annual meeting held in Washington, D.C., in October.

Serving one-year terms will be: *President*—Jerome J. Crowley, Jr., The O'Brien Corp.; *Vice President*—John S. Dumble, The Glidden Co.; and *Treasurer*—B.F. Mautz, Jr., Mautz Paint Co.

Members elected to serve a one-year term on the Board of Directors are manufacturers Cyriac P. Alexander, Frazee Industries, Inc.; M.C. MacKinnon, United Gilsonite Laboratories; Albert Paolini, The Dexter Corp.; and Joseph M. Quinn, Grow Group, Inc.

Also elected to serve a one-year term on the board is supplier member Ernest Scheller, Jr., Silberline Manufacturing Co.

Serving a two-year board term is supplier Nicholas T. Cullen, Mobay Corporation.

Members serving a two-year board term are manufacturers Peter E. Flood, The Flood Co.; James A. Weil, INSL-X Products Corp.; and supplier Melvin B. Scott, Jr., Eastman Chemical Products, Inc.

Manufacturing members serving three-year board terms are William L. Bowers, Bruning Paint Co.; Robert E. Champagne, Courtaulds Coatings, Inc.; Larry Hecht, Superior Sealants, Inc.; Leonard P. Judy, Rust-Oleum Corp.; Merritt E. Marcus, Marcus Paint Co.; Eugene B. Mosier, PPG Industries; John H. Sadler, Moline Paint Mfg. Co.; Louis F. Savelli, E.I. du Pont de Nemours & Co., Inc.; Raymond D. Stevens, Jr., Pratt & Lambert, Inc.; Maurice C. Workman, Benjamin Moore & Co.; and C. Angus Wurtele, The Valspar Corp.

Suppliers serving a three-year term on the board are A.J. Carbone, The Dow Chemical Co.; F.J. Costello, Union Carbide Corp.; Alan M. Holzberg, Exxon Chemical Co.; and Michael J. Kenny, Rheox, Inc.

NPCA Presents Heckel Award To Jerome Crowley

Jerome J. Crowley, Jr., President of The O'Brien Corporation in South San Francisco, CA, recently received the 1990 George Baugh Heckel Award, the highest award presented by the National Paint & Coatings Association.

Mr. Crowley was honored at the association's annual awards luncheon during its 103rd Annual Meeting in Washington, D.C.

The Heckel Award is given in recognition of a single outstanding achievement in support of NPCA and coatings industry goals.

Mr. Crowley, who is also NPCA's new President, was recognized for his contributions to expansion of the association's state affairs program.

In 1990, he chaired a subcommittee of NPCA's Strategic Planning Committee which was charged with developing plans for establishing state-based lobbying entities for the coatings industry in key states over the next few years. He played a major role in the creation of NPCA's first such group, the California Paint Council, for which he then served as Chairman.

Study Reports Lack of Recent Improvement For Sluggish Construction Sector

Contracting for new construction remained stalled in November, adding to the recent accumulation of adverse economic news, it was reported by the F.W. Dodge Division of McGraw-Hill.

Last month, the Dodge Index of construction contracting slid another one percent from October's already depressed rate to 144, a five-year low. This seasonally adjusted indicator of future construction activity which uses 1982 as its 100 base, represents the value of newly started construction of all kinds.

November's nonresidential building contracts declined eight percent as both commercial and institutional work fell proportionately. The value of the month's newly started housing sagged four percent.

In contrast to recent sluggishness of most categories of construction activity, nonbuilding projects (public works and utilities) surged 16% in November. An $800 million program of pipeline repair/replacement in Alaska, which will extend over the next three to five years, was the source of the spurt. It was also the major factor keeping the month's total construction contract value from falling more steeply.

Through 11 months, 1990's $225.7 billion total of newly started construction projects was 10% below the amount contracted during the year-earlier period. All major regions of the nation are now showing declines, the largest of which are found in the Northeast (-21%), and the South Atlantic (-16%). Smaller than average declines are reported for the South Central (-6%), the West (-5%), and the North Central (-3%).

Morton International, Inc. Occupies New Headquarters

Morton International, Inc. recently moved its corporate headquarters, including the administrative and marketing personnel of its salt and chemicals businesses, to the new Morton International Building located at 100 North Riverside Plaza, Randolph Street, Chicago, IL.

The building is a one-million square-foot, 36-story structure topped off by a six-story illuminated clock tower—an area landmark. It is complete with a two-story atrium lobby, landscaped riverfront park, and 470-space parking garage.

Approximately 850 employees were relocated to the new facility.

Akzo Announces Plant Closing

Akzo Coatings, Don Mills, Ontario, Canada, has announced the closing of its plant in Rexdale, Ontario. The facility, which employs approximately 29 people, produces paints and stains for the industrial and decorative markets.

Operations will be phased out by the end of June 1991, and products currently produced there will be made in other Quebec and U.S. facilities.

Akzo operates in a number of markets, including salts and chemicals, fibers, coatings, and pharmaceutical products.

Crosfield Chemicals to Build Specialty Silica Gel Facility

Crosfield Chemicals, Joliet, IL, a company in the Unilever Specialty Chemicals Group, has announced plans to build a large multimillion dollar facility to produce micronized silica gels at its Joliet site. Construction of the plant is to begin immediately, with completion scheduled for early 1992.

The new facility will be constructed adjacent to Crosfield's silica hydrogel plant. The silica hydrogel facility will provide the feedstock for these specialty silicas.

Marine Anticorrosive and Touchup Coatings Sought

The David Taylor Research Center, Annapolis, MD, is seeking marine anticorrosive coatings such as 100% solids epoxies, water-based epoxies, and water-based acrylics, but not limited to these types, for use in internal shipboard areas such as bilges, machinery spaces, galley areas, wet spaces, and other shipboard areas. These coatings will be used for short term (two years) corrosion control mostly as touchup to existing paint systems. The coatings must be applicable by brush. Compatibility with the existing paint systems, mostly epoxies and alkyd enamels, is required. Coatings for the bilge should have the ability to be applied over surfaces that receive only hand tool cleaning, SSPC SPS-2, and should be easily applied and cured at low temperatures, 20-40°F. After laboratory testing by the Navy, promising candidate coatings will be evaluated for hazardous properties by the Navy Environmental Health Center, including offgas testing for conformance to requirements for breathing air, since the coatings will be used in confined spaces. No coatings with known health hazards, such as carcinogens, flash points below 100°F, or a VOC greater than 340 grams/waterless liter will be considered. Questions may be addressed to Albert Holder, (301) 267-2275 or Steve Hobaica, (301) 267-2751. Product literature and Material Safety Data Sheets can be sent to Mr. Holder or Mr. Hobaica at the following address: David Taylor Research Center, Attn: A. Holder or S. Hobaica, Code 2841, Annapolis, MD 21402.

* * *

In addition, the David Taylor Research Center is seeking improved marine anticorrosive touchup coatings, such as 100% solids epoxies, water-based epoxies, and high solids epoxies; improved surface preparation methods for touchup; and cleaners for steel surfaces that remove contaminants and give a better surface over which to paint. The major contaminants on these surfaces are salt, oil, and tight rust. The coatings should last at least four years in an alternating seawater immersion/atmospheric drying environment. The coatings will be brush applied over poorly prepared contaminated surfaces and must adhere to aged epoxy paints that have been roughened. It is also desirable that the coatings should be capable of curing at 40°F or lower. A flash point of 100°F (as determined by ASTM D93 Pensky-Martens closed cup tester) and VOC of approximately 300 grams/waterless liter are required. No coatings with known or suspected health hazards or toxic materials such as carcinogens, lead, or chromate will be considered. Technical data sheets and Material Safety Data Sheets will be screened and should be sent to David Taylor Research Center, at the address noted previously. Questions may be addressed to Steve Hobaica, (301) 267-2751.

BASF Consolidates Canadian Businesses

BASF has announced a consolidation of its three major Canadian businesses, BASF Canada Inc., BASF Coatings & Inks Canada Ltd., and BASF Fibres Inc., into a new corporation to be called BASF Canada. The new organization was scheduled to become effective as of January 1, 1991.

W.R. Grace and Dexter Complete Business Unit Exchange

The Dexter Corporation, Windsor Locks, CT, and W.R. Grace & Co., New York, NY, have finalized a purchase and sale agreement for the exchange of Dexter's Mogul® Water Management Systems European business for Grace's European-based mold release business, a unit of Grace Specialty Chemicals Co.

The Dexter businesses are located in Germany, Holland, and Belgium and will become a part of Grace's Dearborn® water treatment services and Grace Process Chemicals headquartered in France.

The Germany-based mold release business will be integrated into Dexter Adhesives & Structural Materials Division.

The business will report to Charles F. Call, Vice President and General Manager of Industrial Products, of Seabrook, NH.

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Regulatory UPDATE

FEBRUARY 1991

This digest of current regulatory activity pertinent to the coatings industry is published to inform readers of actions which could affect them and their firms, and is designed to provide sufficient data to enable those interested to seek additional information. Material is supplied by National Paint and Coatings Association, Washington, D.C.

Legislation—Because of the activities in the Persian Gulf, Congress has yet to set a legislative agenda regarding domestic issues. However, there has been some discussion of the possibility of action on the following environmental topics.

Clean Water Act—Senate staff has indicated a preference to move Clean Water legislation before beginning debate on the long over-due reauthorization of the Resource Conservation and Recovery Act (RCRA).

Last year, Senate Majority Leader George Mitchell (D-ME), introduced legislation, S. 1178, that would set a national across-the-board standard for combined sewer overflows (CSOs), and establish stringent deadlines for compliance. The bill met with strong opposition from the Environmental Protection Agency (EPA) and cities who said that a national standard approach is "unrealistic" and the cost of the CSO requirements would be astonishing. Environmentalists have said they would promote Mitchell's bill during the 102nd Congress, while EPA and a coalition of cities and towns both hope to push a less stringent approach.

Another contentious issue facing Congress is whether certain developers would be exempt from the Clean Water Act when building on "wetlands." Section 404 of the Act gives EPA veto authority for permits for development of wetlands. The issue is rapidly becoming a political one, and some staff would prefer not to have to amend it, for fear of delaying reauthorization indefinitely.

Resource Conservation and Recovery Act (RCRA)—If and when Congress decides to begin debate on the reauthorization of RCRA, the Senate and House will probably use different bills as their principal vehicles. The new chairman of the House Energy and Commerce Subcommittee on Transportation and Hazardous Materials, Rep. Al Swift (D-WA), has indicated he will draft a new bill as opposed to using legislation left over by his predecessor, Tom Luken (D-OH), who retired in November. Luken was criticized last year for dropping all but the solid waste provisions of the "comprehensive" measure. In the Senate, the Environment and Public Works Committee will undoubtedly begin with a bill introduced in 1989 by Sen. Max Baucus (D-MT). For both Houses, Subtitle C of RCRA (hazardous waste) is the source of controversy that could stall the reauthorization once again.

Pollution Prevention—The EPA is ready to present to Congress its pollution prevention strategy. The Administration-approved plan would reduce the 15 or 20 most toxic chemicals by 50% by 1995 through a voluntary industry program. The Office of Management and Budget opposes the strategy because it is not cost effective, and could interfere with the proper accounting of toxic releases required by Title III of SARA.

Lender Liability—Despite the extension of the Superfund program until 1994, lender liability is an issue that will probably see some action this year. Last year, EPA drafted a rule to try to clarify Superfund language that exempts from liability lending institutions, including government agencies, from clean up costs when they foreclose on contaminated properties. Several federal agencies oppose the rule because it is not broad enough. Instead they are urging an Administration-supported bill to ensure protection for government lending agencies. Both congressional and EPA staff have acknowledged that the primary reason for the rule and proposed legislation is to protect federal government agencies that foreclose on properties owned by the collapsed savings and loans.

Environmental Protection Agency
December 14, 1990—55 FR 51532
Hazard Ranking System
Action: Final Rule

The Hazard Ranking System (HRS), which is the principal mechanism for placing sites on the National Priorities list, is being amended by the EPA.

The changes will revise the way EPA evaluates potential risk to human health and the environment from hazardous waste sites. It is also EPA's intention to tighten the accuracy of the HRS when assessing potential risk. The revisions are in compliance with other statutory requirements under the Superfund Amendments and Reauthorization Act (SARA).

For further information, contact Steve Caldwell or Agnes Oritz, Hazardous Site Evaluation Division, Office of Emer-

gency and Remedial Response, OS-230, U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460; or call the RCRA/Superfund Hotline at (800) 424-9346.

Industrial Furnaces and Boilers will be Regulated—The EPA has announced that they will regulate approximately 1000 industrial furnaces. Up until now, facilities burning hazardous waste for energy recovery had been exempted while EPA determined appropriate control levels.

The facilities affected by this rule are used to burn almost all of the country's hazardous waste. They consist of 75 large industrial furnaces including cement kilns, and 125 boilers. Exempted from the rule, are nearly 600 smaller boilers which burn less than one-percent the nation's waste. However, the smaller boilers will still have to comply with specific recordkeeping and notification requirements. As a result of the new rule, an additional 200 facilities will also be expected to stop burning hazardous waste, according to the EPA announcement.

At a cost to industry of up to $10 million a year, facilities affected by the rule will have to comply with emission standards for metals, hydrogen chloride, and "products of incomplete combustion." The rule is expected to appear in the Federal Register within the next couple of months.

For further information, contact Robin Woods, EPA Public Affairs Office, (202) 382-4377.

Environmental Protection Agency
January 2, 1991—56 FR 24
Underground Storage Tanks; Technical Requirements
Action: Interim Final Rule

The EPA has published in the Federal Register an interim final rule extending until September 22, 1991, technical requirements for underground storage tanks (USTs).

Owners and operators of USTs have an extra 270 days to install automatic line leak detectors that detect a specific leak rate with a probability of detection of 0.95 and a probability of false alarm of 0.05. EPA extended the original deadline (December 22, 1990) because the technology was not available to all owners and operators of USTs. Under this amendment, owners and operators are still required to equip all new or existing pressurized piping with automatic line leak detectors and either conduct an annual line tightness test or conduct monthly monitoring.

The extension does not apply to other detection methods such as tank gauging, tank tightness testing, and line tightness testing. Those methods must meet the original deadline.

For further information, contact the RCRA/Superfund Hotline at (800) 424-9346.

Environmental Protection Agency Designates Wood Preserving Operations as Hazardous—The EPA has announced that three categories of waste from wood preserving operations have been designated as hazardous. A permit under the Resource Conservation and Recovery Act (RCRA) must be obtained by companies who keep the wastes on their premises for more than 90 days.

The categories of wastes are from wood preserving operations that use chlorophenolic, creosote, and/or inorganic (arsenical and chromium) preservatives. The final listings include wastewaters, process residuals, preservative drippage, and spent preservatives from wood preserving processes that use or have used chlorophenolic formulations, facilities that use creosote formulations, and facilities that use inorganic preservatives containing arsenic or chromium.

Until further information can be collected, EPA is deferring a final listing of wastes from surface protection processes that use chlorophenolic formulations. The Agency did say however, that these wastes could exhibit Toxicity Characteristics and may already be regulated under Subtitle C of RCRA. Also included in the rule are permitting and interim standards for drip pads used to collect treated wood drippage. These standards include requirements for drip pad design and operation, inspections, and closure. A 90-day generator exemption could be granted if their drip pads meet all of the technical standards for drip pads. The final rule becomes effective on June 6, 1991.

For further information, contact the RCRA/Superfund Hotline at (800) 424-9346. For technical information, contact Ed Freedman or Edwin F. Abrams of the Office of Solid Waste (OS-333) at (202) 382-4770.

Department of Transportation—Research and Special Programs Administration (RSPA)
December 21, 1990—55 FR 52402
Performance-Oriented Packaging Standards; Changes to Classification, Hazard Communication; Packaging and Handling Requirements Based on United Nations Standards and Agency Initiative
Action: Final Rule

The Department of Transportation (DOT) has issued a final rule that revises the Hazardous Materials Regulations (HMR; 49 CFR parts 171-180), regarding hazard communication, classification, and packaging requirements.

The revisions were initiated by the Research and Special Programs Administration of the DOT, and are based on the recommendations of the United Nations (U.N.) regarding the transport of dangerous goods. The RSPA explained that the revisions were made because the existing HMRs are: "(1) difficult to use because of their length and complexity; (2) relatively inflexible and outdated with regard to non-bulk packaging technology; (3) deficient in terms of safety with regard to the classification and packaging of certain categories of hazardous materials; and (4) generally not in alignment with international regulations based on the U.N. Recommendations."

According to RSPA officials, the rule will allow more flexibility and better technology in packaging; reduce the volume of the HMRs, and make them more understandable; promote safety through clearer classification and packaging; cut down on the need for exemptions from the HMR; and facilitate international commerce.

The effective date for the rule is October 1, 1991. Petitions for reconsideration must be received before March 21, 1991. Comments and petitions should be sent to the Dockets Unit, Research and Special Programs Administration, Department of Transportation, Washington, D.C. 20590-0001. Comments should show the docket number and five copies must be submitted. For further information, contact Delmer Billings at (202) 366-4488, Office of Hazardous Materials Standards, or Charles Hochman, (202) 366-4545, Office of Hazardous Materials Technology.

States Proposed Legislation and Regulations

Alabama

Air Quality—The Department of Environmental Management has incorporated revisions from the Jefferson County Health Department Air Pollution Control Regulations into the Department's Air Rules and Regulations. The regulations apply only to volatile organic compound sources. For more information, contact Tommy E. Bryan, Hearing Officer, Office of General Counsel, Alabama Department of Environmental Management, 1751 Cong. W.L. Dickinson Drive, Montgomery, AL 36130.

California

Air Quality—A. 157 (Roybal-Allard) authorizes an air pollution control officer to require specified information from a supplier of volatile organic compounds or chemical substances, and requires the supplier to disclose that information. Makes failure to comply a misdemeanor.

A. 187 (Tanner) provides that substances listed in recently enacted amendments to the Clean Air Act are toxic air contaminants. Requires the State Air Resources Board to compile and maintain a list of those substances.

A. 212 (Tanner) makes various findings and declarations relating to the development of a plan for state action to determine risks posed by exposure to indoor air pollution.

S. 46 (Torres) revises the definition of toxic air contaminant to delete an exclusion for pesticides, and to include a description of cancer-causing substances. Redefines the threshold level below which no health effects are anticipated. Imposes new duties on the affected agencies, including air pollution control districts and air quality management districts with respect to reducing or eliminating emissions of toxic air contaminants.

S. 84 (Torres) defines the term volatile organic compounds and requires a generator of these compounds to pay a surcharge to the Board of Equalization, at a rate set by the Board to generate $20,000,000 per year. The money will be used to cleanup or abate groundwater.

S. 124 (McCorquodale) creates the San Joaquin Valley Air Quality Management District.

Toxic Substances—S. 48 (Torres) requires a registration form to be filed annually concerning hazardous materials. Authorizes an administering agency to have access to the specified information in the handler's possession prior to the implementation of a Risk Management Prevention Program (RMPP).

Florida

Toxic Substances—S. 94 (Souto) requires registration with the Department of Health and Rehabilitative Services of distributors and certain purchasers or possessors of certain listed chemicals used in the manufacture of controlled substances.

Hawaii

Occupational Safety and Health—The Department of Labor and Industrial Relations has proposed safety and health standards that are "at least as effective" as Federal OSHA standards in providing safe and healthy workplaces for Hawaii employees. It specifically introduces a new standard covering hazardous chemicals in laboratories that sets performance provisions designed to protect laboratory workers from hazards in laboratory environments. For more information, contact the Division of Occupational Safety and Health, Room 423, 830 Punchbowl Street, Honolulu, HI 96813.

Illinois

Hazardous Waste—The Pollution Control Board has proposed regulations to update its RCRA underground injection control rules to correspond with amendments adopted by the EPA which appeared in the Federal Register during the period January 1, 1990 through August 31, 1990.

Underground Storage Tanks—The Pollution Control Board has proposed regulations updating its underground storage tank (UST) rules to correspond with amendments adopted by the EPA. For more information on either or both proposals, contact Dorothy M. Gunn, Clerk, Illinois Pollution Control Board, State of Illinois Center, Suite 11-500, 100 W. Randolph Street, Chicago, IL 60601.

Indiana

Construction—H. 1105 (Matonovich) establishes a Hazardous Painting Certificate Program for professional painters. Prohibits the employment of a professional painter to perform hazardous painting unless the professional painter holds a Hazardous Painting Certificate.

Air Quality—The Air Pollution Control Board has proposed regulations clarifying and expanding on existing requirements for volatile organic compound sources. For more information, contact Timothy J. Method, Assistant Commissioner, Office of Air Management, Department of Environmental Management, Second Floor, 105 South Meridian Street, Indianapolis, IN 46225.

Occupational Safety and Health—The Occupational Safety Standards Commission has proposed to incorporate by reference provisions concerning electrical safety related work practices, occupational exposure to formaldehyde, control of hazardous energy sources (lockout/tagout), air contaminants, and others. For more information, contact the Occupational Safety Standards Commission, Indianapolis, IN. Refer to 620 IAC 1-1-31.

Louisiana

Air Quality—The Department of Environmental Quality has proposed to add provisions for a comprehensive toxic air pollutant control program with rules which provide for emission reductions, require records, provide for orders and procedures, fees, and other related matters. For more information, contact David Hughes, Enforcement and Regulatory Compliance Division, 333 Laurel Street, Suite 620, Box 44066, Baton Rouge, LA 70804.

The Department of Environmental Quality has also proposed to establish standards of performance for new stationary sources. For more information, see previously mentioned contact.

Maine

Occupational Safety and Health—The Department of Public Safety has proposed to update regulations for the possession, storage, handling, dispensing, and transportation of flammable and combustible liquids. For more information, contact Stephen Dodge, Office of State Fire Marshal, 317 State St., Station 52, Augusta, ME 04333, (207) 289-3473.

New Jersey

Underground Storage Tanks—A. 2527 (Zangari) requires the Department of Environmental Protection to establish a certification program for persons who perform underground tank services, including tank removal, installation and repair, installation of monitoring systems, and subsurface evaluations for corrective action, closure, and corrosivity.

Toxic Substances—A. 4337 (Cohen/Duch) codifies the "discovery rule" for certain actions for asbestos or lead contamination for statute of limitations purposes.

S. 2220 (Dalton) establishes a regulatory program in the Department of Environmental Protection designed to prevent pollution through the reduction in the use and discharge of hazardous substances. Establishes as a Statewide goal a 50% reduction over five years in the use of hazardous substances, in the discharge of hazardous substances into the air and water, and in the generation of hazardous waste.

Packaging—S. 2261 (Contillo) requires manufacturers and distributors of packaging or packaging materials to reduce the amounts of toxic substances added to packaging or packaging materials used or sold within the state.

New York

Toxic Substances—A. 477 (Kelleher) requires the Commissioner of Environmental Conservation to promulgate a list of all toxic substances and further requires businesses to give notice to the consumers of the existence to such toxics.

S. 371 (Levy) enacts the "children's poison protection act of 1991" to regulate toxic household products by requiring the inclusion within enumerated toxic household products, a bittering agent which is non-toxic, so as to render the product adversely bitter.

Household Hazardous Waste—A. 478 (Kelleher) directs the Department of Environmental Conservation to conduct a household hazardous waste pick-up program on a county-wide basis at least once in each year.

Graffiti—S. 67 (E. Levy) provides that a person is guilty of possession of graffiti implements when he possesses any tool, instrument, article, substance, solution, or other compound designed or commonly used to etch, paint, cover, draw upon or otherwise mark, without permission of authority to etch, paint, cover, draw upon or otherwise mark, under circumstances evincing an intent to use same; such crime to be a Class A Misdemeanor.

North Carolina

Air Quality—A proposed regulation from the Department of Environment, Health and Natural Resources lists the chemicals which after May 1, 1991, may not be emitted by a facility in such quantities that may cause or contribute beyond the premises to any significant ambient air concentration that may severely affect human health. For more information, contact Thomas C. Allen, Division of Environmental Management, P.O. Box 27687, Raleigh, NC 27611-7687, (919) 733-3340.

Ohio

Air Quality—This EPA/Division of Air Pollution Control proposal pertains to the control of volatile organic compound emissions by stationary sources. For more information, contact Jeanne Mallett, Columbus, OH, (614) 644-2115.

Environmental Issues—H. 960 z (Gerberry) establishes a pollution prevention program in the Department of Development and the EPA and imposes a fee on the release of toxic chemicals, generation of hazardous waste, and disposal of solid waste.

Utah

Water Quality—This proposal adopts criteria for 109 toxic pollutants for the protection of human health, adopts criteria for two pollutants for the protection of aquatic life, modifies criteria for six pollutants for the protection of aquatic life. For more information, contact Don A. Ostler, Director, Department of Environmental Health, Division of Water Pollution Control, 288 North 1460 West, Salt Lake City, UT 84116, (801) 538-6146.

Virginia

Hazardous Waste—This proposal updates regulations and conforms them to federal requirements. It contains land disposal restrictions, adopts a new toxicity characteristic test, expands the list of the organic substances for which waste needs to be tested, and sets standards for air emissions at hazardous waste treatment, storage, and disposal facilities. For more information, contact W. Gulevich, Department of Waste Management, 101 N. 14th Street, Richmond, VA 23219, (804) 225-2975.

Washington

Hazardous Waste—This proposed regulation would implement the requirements for facility plans and related documents required from certain hazardous waste generators and hazardous substance users.

This proposal would implement the collection of a $35.00 annual fee from known and potential hazardous waste generators, and an additional fee from large quantity hazardous waste generators and hazardous substance users. For information on either or both proposals, contact Bob Lemcke, Department of Ecology, Mailstop PV-11, Olympia, WA 98504-8711.

1991 EDUCATIONAL COMMITTEE GUIDE TO COATINGS COURSES, SYMPOSIA, AND SEMINARS

This compilation of courses, symposia, and seminars on coatings-related topics is based on information obtained from Constituent Societies of the Federation, educators, and various industry sources. The contents are listed by geographic region, then alphabetically by Society.

Structured courses are listed first, followed by a separate listing for symposia, seminars, and workshops, and one for international events.

The Guide is updated annually, and anyone interested in doing so is invited to forward additions, changes, corrections, etc., so that the contents will reflect current up-to-date information.

Address all correspondence to: Educational Committee (Coatings Courses), c/o Federation of Societies for Coatings Technology, 492 Norristown Road, Blue Bell, PA 19422-2350.

COATINGS COURSES

CENTRAL

CHICAGO

DePaul University, Chicago, IL

Masters Degree in Chemistry/Coatings Technology—Program, endorsed by Chicago Society for Coatings Technology, requires admission to DePaul Graduate School. Candidates should have earned B.S. of Science degree in chemistry or its equivalent. The 12-course curriculum requires about six quarters of study, including five advanced courses in organic chemistry, inorganic chemistry and physical chemistry. Three courses in polymer chemistry and four courses in coatings technology (two of which are coatings laboratory courses) are listed below.

Coatings Laboratory I (CHE 461)—Held on Saturday mornings (4-hour sessions), this course is designed to introduce individuals to the definitions, concepts, and methodologies commonly practiced by the coatings laboratories. These include paint compositions, properties, testing and analysis, rheology, film formation, hiding power and wetting.

Coatings Laboratory II (CHE 463)—This course, held on Saturday mornings (4-hour sessions) involves the experimental techniques in synthesis and characterization of polymers used in coatings industry. Synthesis of polymers by free radical, emulsion, redox, ionic, and condensation polymerizations are introduced. Characterization of the polymers by spectroscopy, viscosity, and thermal techniques are introduced.

Coatings Technology I (CHE 460)—This course involves an overview of coatings industry, coatings formulation (physical chemistry of coatings and coatings composition and properties), color theory and reduction to practice, coatings manufacture and application, surface chemistry of metals, and government/regulatory consideration. Offered every two years.

Coatings Technology II (CHE 462)—This course focuses on the binders used in the coatings industry. The major classes of binders, their preparation, characterization, and use in paints are surveyed. Surface characterization of films and coatings are also surveyed. Offered every two years.

Polymer Synthesis (CHE 430)—This course is designed to introduce the basic concepts of polymers, various definitions, and the physical and organic chemistry of the reactions by which polymer molecules are synthesized. Offered every two years.

Physical Chemistry of Polymers (CHE 432)—This course looks at the broad subject of the physical chemistry of polymers: mechanical behavior (rheology, viscoelasticity); the several states of polymers (glassy, crystalline, molten and solution, and elastomers or rubbery polymers); transport properties; fabrication (of fibres, films and foams); kinetics of polymerization: and molecular weight determinations and polymer identifications. Offered every two years.

Polymer Characterization (CHE 434)—This course discusses the various chemical spectroscopic, physical, and mechanical methods of analysis of polymers to understand the structure property relationship of polymers. Offered every two years.

Contact: Dr. Sharf U. Ahmed, Department of Chemistry, DePaul University, 2323 N. Seminary Avenue, Chicago, IL 60614 (312) 362-8185 or 362-8180.

Ramada Hotel, O'Hare, Chicago, IL

Estimating for Painting Contractors and Maintenance Engineers—Mar. 18-20. This comprehensive three-day short course is being offered twice this year (also presented April 8-10, in Atlanta) by the Foundation for Chemical Research, and covers blueprint reading, specifications, quantity take-offs, pricing structures and problem solving. The class works from actual plans in as near a real-life

situation as possible. The instructor for this course is Len A. Hijuelos. He has specialized in estimating, primarily for industrial work, and has assisted in the development of training programs, and new curriculum for the painting industry. Fee: $545.

Contact: Suzan Yelek, Estimating, Foundation for Chemical Research, P.O. Box 1401, Rolla, MO 65401 (314) 341-3406 or 364-5880.

CLEVELAND

KENT STATE UNIVERSITY, KENT, OH

(The following five courses can be used for regular college credit.)

Surface Coatings I (Chemistry 40093)—Sept. to Nov. (Fall '91 and every third year). Held on Saturday mornings (3-hour sessions), this 12-week basic coatings technology course is designed for junior technicians, new employees and individuals entering the coatings industry. Introductory chemistry or prior experience in the coatings industry is required for admission. College credit is offered upon successful completion of a final examination.

Surface Coatings II (Chemistry 40093—Undergraduate; Chemistry 50093 or 70093—Graduate)—Sept. to Nov. (Fall '92 and every third year). Held on Saturday mornings (3-hour sessions), this course is designed for experienced coatings personnel. Subjects included are: resin moieties and polymerization techniques—nonaqueous; polymerization techniques—emulsion and water soluble; intrinsic properties; rheology theory nd instrumentation; solvents and solubility parameters; CPV concentration; inorganic and organic color pigments; white pigments and extenders; mechanical properties; diffusion; and accelerated and natural weather testing.

Surface Coatings III (Chemistry 40093—Undergraduate;Chemistry 50093 or 70093—Graduate)—Sept. to Nov. (Fall '93 and every third year). Held on Saturday mornings (3-hour sessions), this is an advanced or graduate study 12-week course, with in-depth lectures on specific topics in coatings science and technology. Course content is entirely different from Surface Coatings II. Subjects covered include: adhesion; experimental design; polymer and coatings characterization; microvoids; color; electrodeposition; film formation and cure; pigment dispersion; powder coating; radiation curing; and analytical characterization of coatings materials; film formation and cure; phosphatizability of steel and corrosion.

Physical Chemistry of Macro-Molecules (Chemistry 40583—Undergraduate; Chemistry 50583 or 70583—Graduate)—Jan. to May (Spring '91 and alternate years). Two credit hour course designed to cover the basic principles of polymer science. Structure, properties and characterization of polymeric systems are discussed.

Surface Chemistry (Chemistry 40571—Undergraduate; Chemistry 50571 or 70571 Graduate)—Jan. to May (Spring '92 and alternate years). Two credit hour course presenting the treatment of basic principles and concepts in surface and colloid chemistry. Relationship to practical systems are emphasized.

Tuition scholarships supported by the Federation of Societies for Coatings Technology at Kent State University are available for undergraduate students interested in courses for which these scholarship funds are applicable.

(The following three courses can earn Continuing Education Units.)

Applied Rheology for Industrial Chemists—April 22-26. This 4 1/2-day course covers subjects related to rheology, kinematics and dynamics, dispersion, interfacial and polymer rheology, with discussions divided equally between principles and application. Presentations are geared to those with a Bachelor's Degree in a technical or scientific area, and aimed at providing practitioners in the coatings, adhesives, elastomers, and plastics industries with insights which will enable them to write and understand specifications, improve quality control, and learn techniques in rheology. Fee: $650.

Dispersion of Pigments and Resins in Fluid Media—May 6-10. The chemistry and mechanical aspects of the dispersion of pigments and resins in fluid media are covered. Theoretical underpinnings, ranging from fundamentals of dispersion preparation and modification to stabilization, are given. Practical consequences are shown, followed by expert presentation on the operation of a variety of dispersion equipment and plant practice. Fee: $650.

Adhesion Principles and Practice for Coatings and Polymer Scientists—May 20-24. Closely allied with coatings, as well as rheology, the subject of adhesion has profited from theoretical treatments, ranging from principles of bonding to surface chemistry, to a wide variety of mechanical properties. Adhesion principles are discussed first, then applied problems that have been solved in the industrial and academic settings. The course is especially recommended for industrial scientists and technologists who encounter adhesion problems. Fee: $650.

(The following four courses are presented in cooperation with Kent State University Chemistry Department and outside consultants.)

Industrial Painting: Application Methods (KSU and NR Consulting)—Fall '92. This is a 2-day course designed to provide a working knowledge of modern industrial coating methods and technology, and how paint users must adapt to the increased use of lower emission coatings and processes. All application methods are thoroughly discussed, including the safety, economic, and ecological considerations that come into play. Energy requirements for the various modes of paint application and curing are detailed. Topics covered include: substrate cleaning methods; conversion coatings; finishing processes; liquid processes; powder coatings; electrodeposition; water-borne and high-solids coatings; production problems; future trends; and sprayed paint defects. Fee: $425.

Introduction to Coatings Technology (KSU and Pacific Technical Consultants)—Oct. 7-10. This 3 1/2 day introductory course is designed to help technical and non-technical newcomers understand the coatings industry, its challenges and opportunities. It covers the evolution of coatings technology and the progress the coatings industry is making in its rapid change from art to science. Coverage includes many raw materials and their functions in both architectural and industrial finishes, as well as regulatory restrictions, economic forces, and other factors that influence the composition and performance of coatings. Formulation and simple basic calculations are also discussed, including: anatomy of paint and chemicals; weight and volume relationships; comparisons of paints and compositions of coatings; pigment volume concentration; testing procedures; basic quality assurance; safety; pollution control regulations; and waste management. Fee: $625.

Accelerated and Natural Weathering Techniques for Coatings and Polymers (KSU and Portage Technical Consultants)—Oct. 16-18. This 2 1/2-day course is designed to help predict the service life of coatings and polymers by accelerated and natural weathering techniques. Lectures include the variation of accelerated and exterior testing, as well as a correlation between natural weathering with various spectroscopic methods. Accelerated testing of coatings for corrosion control, along with an overview of laboratory accelerated weathering methods are described. Appearance performance modeling for accelerated data is presented, and the correlation of accelerated and natural weathering through FTIR spectroscopy and the uses of fluorescent UV in weather testing is outlined. Fee: $550.

Fundamentals of Chromatographic Analysis (KSU and Spectra-Physics)—Oct. 28-Nov. 1. This 4 1/2-day course is designed to provide a coherent overview of chemical separations via chromato-

graphic methods. It is directed towards the beginning to intermediate chromatographer and is unique from most programs in that material is included on gas, liquid and thin-layer methods. The course stresses the three techniques as complementary, rather than competing, processes and is a blend of fundamental information on theory and instrumentation with applications, including coatings. Fee: $650.

Contact: Carl J. Knauss, Chemistry Dept., Kent State University, Kent, OH 44242 (216) 672-2327.

Case Western Reserve University, Cleveland, OH

Courses are offered by either the Department of Macromolecular Science (EMAC) or by the Department of Chemical Engineering (ECHE), as part of full academic program for B.S., M.S., or Ph.D. degrees in Macromolecular Science and Engineering. Overall coverage of polymer science and engineering includes topics relevant to coatings science and technology, and research projects directly concerned with coatings.

Courses on the 400-level (first and second year graduate students) often are given over the Instructional Television Network (ITN), via VCR cassette, available to students in industry for either audit or academic credit. Call (216) 368-2982, or write ITN, CWRU, Cleveland, Ohio 44106.

Polymer Materials (EMAC 176)—The materials properties associated with the use of synthetic and natural polymers in films, fibers, composites, rubbers, paper, foods, etc., are described and correlated with physical and chemical structures.

Introduction to Polymer Science (EMAC 270)—An introduction to the science and engineering of large molecules; correlation of molecular structure and properties of molecules in solution and bulk; control of significant structural variables in polymer synthesis; analysis of physical methods for characterization of molecular weight, and morphology.

Polymer Analysis Laboratory (EMAC 272)—Experimental techniques in polymer synthesis and characterization; synthesis by free radical emulsion, anionic and condensation polymerization; investigation of polymer structure by x-ray diffraction, electron microscopy, infrared, NMR and circular dichroism spectroscopy; molecular weight determination by light scattering and viscosity measurement; study of chemical and mechanical properties.

Polymer Properties and Design (EMAC 276)—Engineering properties of polymers and their evaluation in terms of selection and design procedures. The relation of properties to the chemical and physical structures of polymers and application conditions.

Polymer Engineering (EMAC 376)—Mechanical properties of polymer materials as related to polymer structure and composition. Introduction to melt rheology and electrical, optical, and surface properties of polymers.

Polymer Processing (EMAC 377/477)—Rheological, molecular, structural, engineering, and compounding factors affecting processibility and properties of polymers; principles and procedures for extrusion, melting, calendering, injection molding, coatings and other primary processing methods. Considerations of pertinent mechanisms and theories with emphasis on the application of theory to practice.

Polymer Production and Technology (EMAC 378)—Engineering operations for industrial polymerization procedures. Finishing and fabrication of polymers. Production and technology of plastics, elastomers, fibers, and coatings.

Polymer Processing and Properties Laboratory (EMAC 379)—Experimental and industrial production techniques and practice in mixing, plastics processing, elastomer extrusion, fiber and composites production. Testing of plastics, elastomers, fibers, coatings and composites. Maintenance and quality control. Processing project.

Macromolecular Synthesis (EMAC 470)—The organic chemistry of macromolecules. The mechanisms of polyreactions, the preparation of addition, condensation and biopolymers, and the chemical reactions of polymers.

Physical Chemistry of Macromolecules (EMAC 472)—The major areas of the physical chemistry of macromolecules are treated; theories and experimental methods of polymer solutions, physical methods for determination of chemical structure and configuration.

Macromolecular Physics (EMAC 474)—Introduction to the physics of amorphous and crystalline polymers. Equilibrium elastic properties of rubbery materials. Viscoelasticity. The liquid-glass and glass-glass transitions. The morphology, characterization and deformation behavior of crystalline polymers.

Applied Macromolecular Science and Engineering (EMAC 476)—Properties, processing and technology of plastics, elastomers, fibers, films, and coatings. The mechanical behavior of polymers related to polymer structure and compostion.

X-Ray Crystallography (EMAC 479)—A basic description of the scattering of x-rays by crystalline and semicrystalline solids including polymers. Techniques of structure analysis.

Polymer Composite Processing (EMAC 481)—Factors affecting the selection of composite processing methods. Characteristics and applications of compression, injection and reinforced injection molding of composites. Filament winding and pultusion methods.

Fundamentals of Adhesives, Sealants, and Coatings (EMAC 482)—The principles of film formation, film application methods, and related fabrication factors and procedures. Relevant adhesion theories and practices, aspects of rheological treatments, optical and other factors which affect applications. The nature and properties of constituent polymer materials, pigments, solvents, and other additives. Selection and design of systems for mechanical, surface environmental resistance, and other properties.

Macromolecular Synthesis II (EMAC 570)—A series of advanced topics in methods and mechanisms of polymerization of synthetic and biopolymers. Coordination, emulsion, ionic and topochemical polymerizations. Novel polymerization methods.

Physical Chemistry of Macromolecules II (EMAC 572)—A series of advanced topics in the physical chemistry of polymers, including conformational statistics of flexible chains, optical properties of polymers and the physical chemistry of biological materials and systems.

Polymer Rheology (EMAC 575)—A systematic study of deformation and flow of matter, with emphasis on polymeric and colloidal systems; topics include rheology of non-Newtonian fluids, the flow properties of simple fluids and dispersions, linear viscoelasticity, polymer solutions and melts, and applications to processing of polymers.

Selected Topics in Macromolecular Synthesis (EMAC 670); Physics (EMAC 671); Physical Chemistry (EMAC 672); Special Topics (EMAC 690)—Content varies depending on the interests of the students and faculty. The topics presented represent advanced and special topics at the forefront of the science and engineering of polymers and polymeric systems. Courses are given on a demand basis.

Characterization of Macromolecules (EMAC 678)—Laboratory experience is gained with the synthesis and characterization of poly-

mers. Methods used include light scattering, viscosity infrared, circular dichroism and NMR spectroscopy. Solid samples are characterized by x-ray diffraction, electron microscopy and differential thermal analysis.

The Scientist in the Industrial Environment (EMAC 691)—Course conducted on a seminar basis, focusing on how R&D management plans, justifies and operates within the corporate structure and the areas which R&D encounters in so doing - finance, law, purchasing, manufacturing, marketing and environmental control.

Surfaces and Adsorption (ECHE 464)—The structure of interfaces including 2D symmetry, the thermodynamics of interfaces, nature of interactions across phase boundaries, wetting, spreading and surface energetics, adsorption on liquid and solid substrates, properties of adsorbed films; instrumental methods in surface science.

Dispersion and Emulsion (ECHE 466)—The structure and dynamics of dispersions, measurement techniques, electrokinetic phenomena, stability, DLVO, stochastic processes; investigation of colloid systems, including emulsions, micro-emulsions, sols, gels and foams; filtration processes.

Courses also are offered in: Polymers in Medicine (EMAC 471); Biopolymers (EMAC 473); and Characterization of Biopolymers (EMAC 475).

(The Interuniversity Center for Adhesives, Sealants and Coatings (ICASC) has been established as a joint venture of Case Western Reserve University and the University of Akron. The Center presents short courses on various topics. ICASC is a cooperative, interdisciplinary research organization involving members of the universities' faculties, and is sponsored by a number of industrial firms. Representatives of the sponsoring companies are actively involved in technical committees which define and guide the research projects. ICASC Office: (216) 368-5030.

Contact: Charles E. Rogers, School of Engineering, Dept. of Macromolecular Science, Case Western Reserve University, Cleveland, OH 44106 (216) 368-6376.

University of Akron, Akron, OH

Frontiers in Polymer Chemistry—April 29-May 1. Offered by the American Chemical Society, this three-day intensive course is of special benefit to researchers and managers concerned with the synthesis of new polymers. Topics covered include: free radical polymerization; emulsion polymerization and latex technology; cationic and anionic polymeriztion; computer simulation of polymer forming processes; molecular design of synthetic biomaterials; condensation polymerization; water-soluble polymers—synthesis and applications; and coordination polymerization. Enrollment limited to 35. Fee: ACS members, $1095; non-members $1295 (includes tuition, course materials, and all lunches).

Designing Macromolecules for Specific Applications—June 26-28. This 3-day short course, offered by ACS, is aimed at experienced industrial managers or researchers in polymer chemistry. Lectures cover the most promising innovations in the field, such as the latest developments in living carbocationic polymerizations, industrial uses of diene-styrene block copolymers, studies on successful commercialization of liquid crystalline polymers, and polymerization chemistry of macrocyclic oligomers. Enrollment limited to 35. Fee: ACS members, $1095; non-members, $1295 (includes tuition, course materials, and all lunches).

Contact: Pamela McInally, Short Courses Registrar, American Chemical Society, 1155 Sixteenth St. N.W., Washington, DC 20036 (202) 872-4508, Ext. 627 or (800) 227-5558.

DETROIT

University of Detroit, Detroit, MI

Introduction to Polymer Engineering & Science I & II—Part of the undergraduate (CHM 420 & 421) and advanced (CHM 550 & 551) degree program, this two-semester course gives an introductory overview of terminology, synthesis, properties, and fabrication of polymers. Prerequisities: one year of undergraduate organic and physical chemistry. Offered Term I (CHM 420/550) and Term II (CHM 421/551) each academic year.

Polymer Surface Coatings I & II—This two-semester course (CHM 425/525 & CHM 426/526) covers the physical, chemical and mechanical properties of polymers as they relate to surface coatings. Prerequisite: CHM 420/550. Offered Term I (CHM 425/525) and Term II (CHM 426/526) each academic year.

Synthesis and Characterization of Macromolecules—Lecture and Laboratory—The lecture (CHM 534) gives a practical discussion of the reactions and techniques involved in the preparation of polymer samples, their purification and characterization. The laboratory (CHM 535) is designed to complement the lecture. Prerequisites: CHM 420/550, one year undergraduate organic chemitry. Offered Term II in each academic year.

Science and Technology of Adhesion—This lecture course (CHM 601) discusses the theory and mechanism of adhesion; natural adhesives; the classification, preparation, and properties of synthetic adhesives; industrial application of adhesives. Prerequisite: CHM 420/550. Offered Term I in odd-numbered years.

Contact: Dr. John A. McLean, Jr., Chairman, Department of Chemistry, University of Detroit, 4001 W. McNichols, Detroit, MI 48221-3090 (313) 927-1258.

Tuition scholarships supported by the Federation of Societies for Coatings Technology at the University of Detroit are available for undergraduate students interested in courses for which these funds are available.

The following evening classes, co-sponsored by the Detroit Society for Coatings Technology, are offered twice a year, September and January. Each student receives a Continuing Education Certificate upon successful completion of course. All fees include text materials for course.

Surface Coatings Technology (10 weeks/20 hours)—This course is designed for new employees and individuals entering the coatings industry. Some of the subjects covered are: principles of formulation; pigment dispersions; paint calculations; paint driers and additives; formation and structure of paint films; solvents. Fee: $220.

Fundamentals of Automotive Paint Systems (10 weeks/15 hours)—This course is a comprehensive survey of basic automotive paint raw materials and process systems. Fee: $220.

Electrodeposition (6 weeks/12 hours)—This course covers: history and evolution of E-Coat; metal pretreatment and E-Coat chemistry; calculations for feed makeup; ultrafiltration; anolyte; trouble-shooting. Fee: $160.

Coatings Laboratory (8 weeks/16 hours)—This is a hands-on course which covers the use and operation of equipment used in quality control and R & D laboratories. Tests are also conducted which relate to paint manufacturing processes and how these relate to field performance. Fee: $180.

Polymer Technology for Coatings (10 weeks/17-1/2 hours)—The sessions include lectures on basic polymer concepts, polymers

commonly used in coatings, and the relationship between the structure of the polymers and the properties of the coatings. Polymers for automotive coatings are emphasized. Fee: $220.

Principles of Color Technology (7 weeks/14 hours)—Introductory course for those having no previous education in the field. After the first night (lecture), the following sessions consist of matching four solid colors and eight "metallics." Students do their own individual spraying. (Registration is limited to six students). Fee: $350.

Environmental Chemistry (10 weeks/20 hours)—Chemical principles of environmental systems are examined, including the atmosphere, water systems, land and biosphere. Practical application is made to industrial and environmental control processes. Fee: $220.

All courses are taught by experts in the paint and coatings industry from such companies as Mercury Paint, BASF/Inmont, Mt. Clemens Coatings, and Chrysler Corp.

A certificate is awarded for successful course completion.

In addition to these courses, the Division of Continuing Professional Education at University of Detroit offers custom-designed in-plant training to address specific company needs.

Contact: Dr. Lloyd Wedberg, Div. of Continuing Professional Education, University of Detroit, 4001 W. McNichols, Detroit, MI 48221-3090 (313) 927-1025.

Eastern Michigan University, Ypsilanti, MI

Three possible degrees are offered in the College of Technology which encompass the polymer and coatings courses as a part of the curriculum: (1) B.S. in polymer and coating technology; (2) M.S. in polymer technology; (3) M.S. in independent study, which can encompass as many as 18 hours in various business courses.

The following 15-week courses comprise the polymer and coating program within the College of Technology:

Polymer and Coatings Technology I (IDT-400)—Fall Semester (Sept. to Dec. - 3 Sem. Hours); Polymer and Coatings Technology II (IDT 402)—Winter Semester (Jan. to April - 3 Sem. Hours). Basic concepts of coating technology which includes polymer, pigment and solvent interaction within the scope of film-forming phenomena. The chemistry of the most common film formers, such as alkyds, acrylics, phenolics, cellulosics, etc., are reviewed, with special emphasis on structure vs. film performance. The pigment binder and pigment volume concentration relationships are reviewed, with accompanying calculations and computer software applications.

Polymer and Coating Technology Laboratory I (IDT-401)—Fall Semester (Sept. to Dec. - 3 Sem. Hours); Polymer and Coating Technology Laboratory II (IDT-403)—Winter Semester (Jan. to April - 3 Sem. Hours). The synthesis of most polymers used in coating technology such as alkyds, thermoset acrylics, emulsions, etc., with subsequent formulation into coatings. Special emphasis is on film-forming properties vs. the various structures which can be formed on the various polymers synthesized. Included are application, and evaluation and cure techniques most prevalent in the coatings industry.

Advanced Coating Concepts (IDT-460)—Winter Semester (Jan. to April - 3 Sem. Hours). A combination laboratory and lecture course which emphasizes formulation techniques and new technologies. Numerous lectures are given by industrial experts representing a variety of coating raw materials by suppliers to the industry.

Cooperative Education in Polymers and Coatings Technology (IDT 387/487). A paid 12-14 week summer experience in the polymers and coatings industry designed to provide the student with an opportunity to examine the industry and receive on-the-job training prior to graduation. To be taken between the third and fourth years (IDT 487) and, if available, between the second and third years (IDT 387).

Polymer Concepts for Engineers and Technologists (IDT-310)—Fall Semester (Sept. to Dec. - 3 Sem. Hours). This course reviews polymer science, polymerization, polymer modifications, size and weight of polymer molecules, plastics, adhesives, silicones, foams, surface coatings, fiber elastomers, transitions and relaxations in polymers, rheology, and polymer fabrication techniques. Subject matter is designed to prepare the student in the basic polymer concepts needed in the coating course.

Coatings Technology Process Analysis (IDT-562)—Winter Semester (Jan. to April - 3 Sem. Hours). The application of scientific methodology, such as statistical process control, to coating technology to improve reproducibility and reduce variability. Principles of experimental design are also used to maximize useful data with minimal expended effort.

Introduction to Color Technology (IDT-478)—Fall Semester (Sept. to Dec. - 3 Sem. Hours). This is an introductory survey course which blends color measurement and visual aspects of color technology. Pigmentation, dispersion techniques, and hands-on laboratory shading are included. The objective is to develop understanding of color as it relates to industrial processes. The main focus is on practicality; demonstration of theoretical principles manifested by real-world situations are stressed.

Mechanical and Physical Properties of Polymers (IDT-410)—Winter Semester (Jan. to April - 3 Sem. Hours). Detailed study of the mechanical and physical properties of polymers from both theoretical and practical viewpoints. Polymer morphology, transitions and relaxations in polymers, mechanical properties of high polymers, rheology and their relationship to polymer fabrication processes.

Coating Process Technology Curriculum—This program, the first of its kind, is based on a well-defined need for graduates for the coating finishing area who possess specialized knowledge in the chemistry and application of coating materials, e.g., process engineers in the application of organic coatings or in technical service positions with companies that manufacture coatings or process equipment. In addition to the formulation course outlined above, the following 15-week courses are offered as part of this program.

Coating Processes I (IDT 405)—Fall Semester (Sept. to Dec. - 3 Sem. Hours). First in a sequence of courses designed to develop expertise in industrial coating processes, this covers substrate preparation, principles of adhesion, corrosion control, industrial coating materials, industrial coating systems, and regulatory compliance in the coatings industry.

Coating Processes I Lab (IDT 406)—Fall Semester (Sept. to Dec. - 3 Sem. Hours). This laboratory course is designed to provide hands-on experience in industrial coating processes. Experiments are selected to provide experience in substrate preparation, coatings application and industrial coating systems design and operational control.

Coating Processes II (IDT 407)—Winter Semester (Jan. to April - 3 Sem. Hours). Designed to develop expertise in the following areas: Processes and equipment for coatings application, economic analysis of coatings operations, paint defects and line design for productivity and energy conservation.

Tuition scholarships supported by the Federation of Societies for Coatings Technology at Eastern Michigan University are available for undergraduate students interested in this curriculum.

Contact Dr. Taki J. Anagnostou, Program Coordinator, Polymer and Coating Technology, Eastern Michigan University, Ypsilanti, MI 48197 (313) 487-1161.

NORTHWESTERN

North Dakota State University, Fargo, ND

Polymers and Coatings Curriculum—Programs leading to B.S., M.S., and Ph.D. degrees, with majors in polymers and coatings. A full range of chemistry courses is offered, along with the following courses specific to polymers and coatings.

Chemistry of High Polymers—Descriptive course in structure and synthesis of high polymers with primary emphasis on polymers useful in plastics, fibers, and rubber. Relationships between polymer structure and fabrication and properties.

Coatings I, II, and III—Basic principles of film formation. Structure and synthesis of polymers used in coatings with emphasis on relationships between polymer structure and their properties. Pigments. Fundamentals of color science. Solvents and solubility parameters. Rheological properties of paints. Theory and practice of pigment dispersion. Relationship between coating composition and film properties such as adhesion, flexibility, and hardness. Formulation of paints and coatings, means of application and physical testing. Course consists of both lecture and lab.

Physical Chemistry of Polymers—Principles of polymerization and co-polymerization with emphasis on mechanisms and kinetics. Characterization of polymers. Second quarter features lab in which students learn means of characterizing polymers.

Physical Chemistry of Coatings—Principles of adhesion, mechanical properties of films, permeability, rheological characteristics of coatings, surface chemistry, and coatings.

Organic Chemistry of Coatings—Study of organic reactions occuring in a coating film. Emphasis is placed on such topics as photo and thermal degradation and theories of fire retardancy.

Photochemical Aspects of Coatings—Topics in UV curing of coatings, weathering of coatings, and color and appearance in coatings, including photochemical principles. Offered in alternate years.

Special Topics in Current Coatings Technology.

Tuition and fees: Undergraduate, $1914 per year (resident of ND), or $4110 per year (non-resident). Tuition reciprocity available to MN residents.

Scholarships of up to $2250/year supported by the Federation of Societies for Coatings Technology and other organizations at North Dakota State University are available for undergraduate students interested in this curriculum. Teaching and Research Assistantships are available to qualified graduate students; stipends are $10,440/year plus tuition paid by NDSU.

Intensive Short Courses in Coatings Science are taught in June each year. Students live in single rooms in school dorms and dine on campus. Enrollment is limited (36 to 40 students per session).

High Solids and Low VOC Coatings—June 10-14. Advance, 4 1/2-day course intended for R&D personnel formulating or using high solids or carrying out research on raw materials for use in such coatings. Taught on a graduate course research level. Covers physical and organic chemistry principles and relates them to the problems of designing and applying coatings at high solids.

Coatings Science—June 17-28. Two-week course in coatings science for the relatively new chemist in an industrial laboratory who has had little education in coatings, or for the more experienced person who is being transferred to work on coatings-type problems. The course covers the underlying scientific principles involved in coatings and relates them to practical coatings problems. Subjects covered are similar to those in the Coatings I, II, and III courses described previously.

Summer Undergraduate Research Fellowships—PPG Industries, Inc. sponsors a research program for undergraduate chemistry majors who may be interested in entering the NDSU graduate program in polymers and coatings after completing their undergraduate degree. Applications will be welcomed from students now in their Junior year. Recipients will carry out organic or physical chemical research related to the basic scientific problems of the coatings industry. The stipend will be $2,000 for 10 weeks during the summer.

Contact: Dr. Gordon R. Bierwagen, Polymers and Coatings Dept., North Dakota State University, Fargo, ND 58105 (701) 237-7633.

University of Minnesota, Minneapolis, MN

Topics in Coatings Technology: An Introduction to Current Practice (90-20)—June 27-28. Sponsored by the American Institute of Chemical Engineers and the University of Minnesota's Dept. of Chemical Engineering and Materials Science, Center for Interfacial Engineering, and Professional Development and Conference Services. This 2-day course should be of interest to coating engineers and coating operators working with the precision coating of thin films as practiced in the photographic, magnetic media, converting, and other industries. Topics covered include: choosing a coatings system; fluid preparation and handling; roll coating; premetered coating; static electricity and electrostatic assist; coating head design; web handling and drives; and driers and drying. Fee: AIChE members, $650; non-members, $750.

Contact: Claire Walter-Marchetti, Program Director, or Ann Todd, Program Associate, University of Minnesota, Dept. of Professional Development and Conference Services, 219 Nolte Center, 315 Pillsbury Drive S.E., Minneapolis, MN 55455 (612) 624-2027 or 625-9502.

Short Course on Rheological Measurements: Applications to Polymers, Suspensions, and Processing (66-15)—Aug. 19-23. Offered once each year in August, this 5-day intensive course is designed to give practicing engineers and chemists in polymer and coatings manufacture an understanding of the fundamentals of rheology, principles of measurement, and applications of rheology to problem solving. Topics covered include: material functions; steady shear methods; on-line methods; extensional methods; concentrated suspensions; molecular theory; and gels and hydrogels. Fee: $1250.

Short Course on Coating Process Fundamentals (90-19)—June 24-26. This 3 day course is designed for coating engineers who want a deeper understanding of processes and processing problems, and should be of interest to other professionals in the development of coatings and formulation of coatings for processability. It begins with flow, wetting, interfacial, and drying/curing phenomena basic to processes for coating liquids, and ends with practical applications and challenges. Emphasis is on underlying mechanisms, the physical and physiochemical principles that govern them, and related engineering considerations. Slot, slide, roll, blade, dip and spin coating methods are discussed and contrasted insofar as presently possible. The course format is lecture and discussion, augmented with videos/movies and demonstrations. Fee: $775.

Contact: Lona Jean Turner, Program Director, University of Minnesota, Dept. of Professional Development and Conference Services, 315 Pillsbury Drive, S.E., Minneapolis, MN 55455 (612) 625-9516.

EASTERN

BALTIMORE

Catonsville Community College, Catonsville, MD

Basic and Intermediate Coatings Technology—Sept. to Dec. Sponsored by the Baltimore Society for Coatings Technology, this 12-week, continuing education course is designed to meet the needs of technicians and chemists just entering the coatings industry, as well as marketing, production, and administrative personnel who wish to broaden their background in coatings fundamentals or brush-up on theory. Along with a history of paint and the materials used in coating manufacturing, the course presents new trends, advances, and restrictions in the industry. Topics covered include: additives; chemical coatings; marine coatings; emerging technologies; formulation principles; paint calculations; paint films; pigments; resins; and solvents and plasticizers. Successful course completion earns 2.0 CEUs. Fee: $150 (includes text).

Contact: Albert Holder, David Taylor Research Center, U.S. Navy, Code 2841, Annapolis, MD 21402-5067 (301) 267-3659 or Ann Freed, Catonsville Community College, 800 S. Rolling Road, Catonsville, MD 21228 (301) 455-4189.

Hunter Associates Laboratory, Inc., Reston, VA

Color and Appearance—One day introductory course, designed to provide a basic background of color science to those concerned with the measurement of a product's appearance. Included are discussions of color theory, gloss, tolerances, sample preparation, and instrument technology. Optional hands-on laboratory is conducted on following day. Course is presented at various locations around U.S. Fee: $395.

Appearance Measurement—This 2-1/2 day, in-depth course, held twice a year near HunterLab's Reston, VA, facility, includes detailed lectures, experiments, and discussions of color theory, effects of geometric attributes such as gloss and haze on product color and appearance, and thorough descriptions of colorimetry and spectrophotometry. Laboratory sessions provide hands-on experience with visual and instrumental color and appearance measurement and data manipulation. Fee: $795.

Special On-Site Educational Programs—HunterLab offers color and appearance courses tailored to specific requirements and conducted at the work site.

Contact: Richard W. Harold, Manager, Educational Services, HunterLab, 11491 Sunset Hills Rd., Reston, VA 22090 (703) 471-6870.

Virginia Polytechnic Institute, Blacksburg, VA

Polymer Chemistry: Principles and Practice—Mar. 10-15, Aug. 11-16, Dec. 8-13. Offered by the American Chemical Society, this six-day hands-on course offers participants a breadth of exposure to polymer topics from synthesis to manufacture. Working in groups of four or five, attendees perform many varied experiments in the field. In addition to practical lab work, the course also includes lectures by leading experts from the staff of Virginia Tech. Among the topics covered are polymer synthesis, molecular weight determination, characterization of rheological and viscoelastic behavior, polymer structure and morphology, and mechnical testing; elastomers, plastics, and fibers are also discussed. Enrollment limited to 30. Fee: ACS members, $1650; non-members, $1850 (includes tuition, lecture and lab materials, and all lunches).

Polymer Characterization: Thermal, Mechanical and Optical—June 2-7. Offered by ACS, this six-day hands-on course focuses on three major characterization methods utilized or polymer systems. These principles are commonly employed to obtain an understanding of the basic structure-property relationships which define the utilization or applicability of a material. The course provides the participant with the fundamentals necessary to make these mechanical, thermal, or optical characterization measurements on polymer systems. Representatives of equipment manufacturers join the Virginia Tech instructors in discussions and demonstrate new instrumentation. Enrollment limited to 30. Fee: ACS members, $1650; non-members, $1850 (includes tuition, lecture and lab materials, and all lunches).

Polymer Synthesis: Fundamentals and Techniques—May 5-10. This six-day comprehensive hands-on course, offered by ACS, gives participants exposure to the fundamentals and up-to-date technology of the major types of polymer synthesis, and features lectures by experts from industry and the Virginia Tech faculty. The scientist or engineer seeking a refresher course or just entering the polymer chemistry field should find this program valuable as an intensive overview of polymer synthesis. Discussions and questions are encouraged, as well as the exchange of information and ideas among participants. Enrollment limited to 30. Fee: ACS members, $1650; non-members, $1850 (includes tuition, lecture and lab materials, and all lunches).

Applied Rheology and Polymer Processing—Sept. 22-27. This six-day lecture-laboratory course, offered by ACS, is designed to teach chemists and engineers involved in the processing of thermoplastics a qualitative understanding of polymer processing and how rheology can be used to solve polymer processing problems. Topics include flow properties of polymeric fluids and the latest methods for measuring them, the sensitivity of various rheological properties to changes in the molecular structure of polymer systems, and the correlation between polymer flow and the development of structure and morphology. Enrollment limited to 30. Fee: ACS members, $1350; non-members, $1550 (includes tuition, lecture and lab materials, and all lunches).

High Performance Polymeric Adhesives and Composites—Oct. 6-11. This 6-day multi-disciplinary lecture/laboratory course, offered by ACS, has a strong emphasis on the performing aspects of materials, and covers a wide variety of topics relating to the development and manufacture of advanced high performance composites. Participants will gain a better understanding of synthesis, characterization, testing, applications, processing, and long-term properties, and will be sufficiently familiar with micromechanics to integrate into their problem-solving approach. They will also know how to evaluate new polymeric materials for complex structural applications and to identify the easiest ways to measure stress and strain in advanced materials. Enrollment limited to 30. Fee: ACS members, $1650; non-members, $1850 (includes tuition, lecture and lab materials, and all lunches).

Note: These and other courses offered by ACS can be set up for presentation on an in-house basis. Details for such arrangements are available from the ACS Education Div.

Contact: Pamela McInally, Short Courses Registrar, American Chemical Society, 1155 Sixteenth St. N.W., Washington, DC 20036 (202) 872-4508 or (800) 227-5558.

LOUISVILLE

University of Louisville, Louisville, KY

The following evening courses (each 5 weeks, 2 hours per week) are presented in conjunction with the Louisville Society for Coatings Technology and offer an integrated overview of the composition, formulation, manufacture, end-use, and application of surface coatings. The courses are designed to complement one another, and need not be taken in any order.

Surface Coatings Technology I—Synthetic Resins—This course provides an overview of the synthetic resins systems used in current coatings technologies, emphasizing structure-property relationships and the benefits and limitations of various resin types. The resin requirements of new coatings technologies (e.g., high solids, waterborne, powder coatings) are included. Fee: $105.

Surface Coatings Technology II—Pigments, Additives, and Solvents—This course offers an overview of non-resinous coating materials—pigments, solvents, plasticizers, and additives. The properties, benefits, and costs of these materials are discussed. Incorporation methods, notably pigment dispersion, are included. Fee: $105.

Surface Coatings Technology III—Coatings Uses and Formulation—This course reviews the various types of chemical coatings, both for trade sales and industrial applications. The principles of coatings formulation are considered. Fee: $105.

Surface Coatings Technology IV—Manufacture and Application of Coatings—This course considers manufacture and application techniques for trade sales and industrial coatings. Surface preparation, curing methods, and paint rheology are also considered. Fee: $105.

Contact: Paul R. Baukema, Akzo Coatings, Inc., R&D Center, P. O. Box 37230, Louisville, KY 40233 (502) 367-6111.

PIEDMONT

University of North Carolina, Greensboro, NC

Polymer Science (CHE 570E)—Jan. to May. This 15-week course is designed to provide a sound background in the physical and chemical principles of polymer science. Topics covered include: polymerization kinetics; characterization of polymer size and molecular weights; polymer structure; properties of polymers in solution; viscoelastic properties of polymers; conducting polymers; and selected applications. Fee: $200, for college credit; $25, for audit.

Contact: Dr. Albert B. Rives, Department of Chemistry, University of North Carolina at Greensboro, Greensboro, NC 27412 (919) 334-5475.

NORTHEASTERN

MONTREAL

College Ahuntsic, Montreal, Quebec

Introduction to Coatings and Ink Technology—Jan. to Mar. Sponsored by the Province of Quebec's Ministry of Education and the Montreal Society for Coatings Technology, this 8-week evening course (6 hours per week) is designed to provide specific information about protective coatings and inks, and a basic understanding of raw materials used, as well as techniques of formulation, manufacturing, and quality control. Presentation made in French. Certificate awarded to students successfully completing course. Fee: $80 (Canadian).

Contact: Alexandre Vignini, Tioxide, Inc., 9999 Boul. Cavendish, Suite 100, St. Laurent, Quebec H4M 2X5 (514) 748-4321.

NEW ENGLAND

University of Lowell, Lowell, MA

Bachelor of Science in Applied Chemistry: Option in Coatings

Master of Science in Plastics with an Option in Coatings and Adhesives

Coatings Science and Technology (26-533/4)—Polymers, pigments, solvents, and additives used in coatings. Methods of polymerization, formulation, application, and testing. Substrates and applications.

Advanced Polymer Science (97-503/4)—Introduction to chain statistics and thermodynamics of macromolecular solutions, methods of study of molecular weight and chain conformation, and the properties of polymers in bulk, including viscoelasticity and crystallinity. A study of the principles of condensation, free radical, ionic, coordination and ring-opening polymerization. The topics include the concepts of step-growth and chain-growth polymerization, the effect of polymerization techniques on reaction kinetics and molecular weight and molecular weight distribution, and the evaluation of reactivity ratios in copolymerization reactions.

Polymer Preparation and Characterization (97-505/6)—Laboratory course designed to acquaint the graduate student with techniques used in synthesis and characterization of macromolecules, concerned with the instrumental study of macromolecules by utilization of osmometry, light scattering, gel permeation chromatography, vapor pressure osmometry, infrared spectroscopy, thermogravimetric analysis and differential thermal analysis.

Mechanical Behavior of Polymers (26-503)—Mechanical properties of bulk polymers as a class of engineering materials. The relation between the chemical/physical structure of polymers and their utilization as plastics, fibers and elastomers. The effect of molecular weight, molecular weight distribution, branching, crosslinking, order and crystallinity on bulk properties. Linear viscoelasticity and its application to creep, relaxation, dynamic and stress/strain response phenomena. The principles and the formulation of time/temperature superposition. The thermodynamic and statistical mechanics view of rubber elasticity. The failure behavior of polymeric materials and its interpretation on the molecular level.

Rheology of Coatings (26-536)—Rheology of polymer melts, solutions, latexes and pigment dispersions, and their application to coatings and adhesives.

Plastics Coatings in Electronics (26-519)—The role of plastic coatings in electronics. Chemical, electrical, thermal, and mechanical characteristics of each major plastic family. Manufacturing technology for applying them.

Adhesives and Adhesion (26-531/2)—Theories of adhesion. Materials and compounding. Methods of application. Adherends and applications.

Colloids (10-506)—Dispersions, solutions, micelles. Surface tension, work and energy, curvature, zeta potential, and surface activity.

Graduate Seminar (26-701/2)—Polymer literature searching, reporting, and discussion.

Graduate Research (26-746)—Individual research projects in polymer chemistry, properties, processing, products, and industry organization.

The B.S. and M.S. programs are offered part-time during the evening. Students may take one or more courses per semester (Sept. to Dec. and Jan. to May). Some students take individual courses for self-improvement, others take the entire curriculum for the B.S. and M.S. degrees.

The M.S. program is also offered full-time during the day. Students take 1-2 years to complete the M.S. degree.

Contact: For the B.S. program—Dr. Philip Lamprey, Chemistry Department, University of Lowell, Lowell, MA 01854. For the M.S. program—Dr. Rudolph D. Deanin, Plastics Department, University of Lowell, Lowell, MA 01854 (508) 934-4000.

Colby-Sawyer College, New London, CT

Gordon Research Conference on Coatings and Films—July 29-Aug. 2. One of a series of conferences held during summer in various New England locations. The five-day coatings conference, featuring speakers and discussion groups, is designed to foster and promote education and science through informal meetings of research scientists with common interests in the fields of chemistry and related sciences.

Contact: Dr. Alexander M. Cruickshank, Director, Gordon Research Conferences, Gordon Research Center, University of Rhode Island, Kingston, RI 02881 (401) 783-4011.

NEW YORK

Macbeth Div., Kollmorgen Corp., Newburgh, NY

Fundamentals of Color—Two-day course designed to offer a basic understanding of color science and its practical application to the problems and solutions associated with the measurement, specification, and control of color in industry. Presented at various locations in the U.S.

Contact: Wanda Smith, Macbeth Division of Kollmorgen Instrument Corp., P. O. Box 230, Newburgh, NY 12550 (914) 565-7660, Ext. 573.

Color and the Behavior of Colorants—A five-day course presenting colorant formulation theory and practical experience in its application. Included are lectures and laboratory sessions which permit actual practice and application of lecture material.

Contact: Elaine Tito, Macbeth Division of Kollmorgen Instrument Corp., P. O. Box 230, Newburgh, NY 12550 (914) 565-7660, Ext. 602.

Fairleigh Dickinson University, Teaneck, NJ

Understanding the Basics of Coatings—Sept. to May. Sponsored by the Joint Education Committee of the New York Society for Coatings Technology and the New York Paint and Coatings Association, this is first part of a two-year, four-semester curriculum (Part II—Advanced Coatings—deals with coatings chemistry and technology). This evening course is suited for individuals just entering the coatings industry and those who wish to gain a broader background in coatings fundamentals. It is designed for persons who have not taken chemistry courses, as well as technologists with some prior training. The first semester covers basic raw materials; the second semester focuses on paint formulation and calculations, dispersion technology, application equipment, and test methods. Advanced Coatings—Sept. to May. This course is designed for those who desire a better understanding of the chemical principles and reactions of coatings. It covers the chemistry of the major vehicle types, curing reactions, and the design of coatings to meet specific application and performance requirements.

Contact: Jeffrey Kaye, MacArthur Petro & Solvent Co., 126 Passaic St., Newark, NJ 07104 (201) 482-4400.

Various Industrial Laboratories

Laboratory Course for Paint Technicians—Offered when local interest necessitates, this 12-week evening course (2 hours per week) is jointly sponsored by the New York Society and the New York PCA and is designed for technicians employed in the coatings industry. A combination of basic theory, demonstrations, and lab exercises, it is aimed at broadening the knowledge and improving the skills of technicians with limited experience. Topics covered include film formation and film properties, dispersion and color pigments, hiding and extender pigments, rheology and viscosity measurement, color measurement and theory, emulsion and latex technology, and solvents—each lecture presented by an expert on the subject and given at the laboratory of the lecturer's employer. Enrollment is limited.

A certificate is awarded for successful course completion.

Contact: Jeffrey C. Kaye, MacArthur Petro & Solvent Co., 126 Passaic St., Newark, NJ 07104 (201) 482-4400.

Polytechnic University, Brooklyn, NY

Graduate Course in Coatings Technology (CH-933)—Sept. (in alternate years). This one-semester course is given in the Chemical Engineering Department of the Graduate School and is part of the Polymeric Materials program taken by candidates for the degrees of M.S. and Ph.D. in Polymer Science and Engineering. Major topics discussed include: organic film formers; solvents and plasticizers; environmental control; mechanisms and methods of film application; pigments and extenders; dispersion; principles of formulation; and specifications and test methods.

Contact: Prof. Paul C. D. Han, Dept. of Chemical Engineering, Polytechnic University, Brooklyn, NY 11201 (718) 260-3162.

Rochester Institute of Technology, Rochester, NY

Colorimetry: An Intensive Short Course for Scientists and Engineers—June 11-13. Designed to teach effective application of colorimetry to persons involved in coatings, textiles, polymers, reprographics, and electronic imaging, this course is particularly valuable for personnel using (or contemplating using) commercial color measuring instrumentation for quality control or colorant formulation. Course objectives are: identify important variables in visually evaluating color and color difference; derive in detail the CIE System of Colorimetry; study the accurate calibration and correct use of

current color measuring instruments; identify proper measurement technique for a given material; develop methods to apply colorimetry to quality control; and develop methods to generate color tolerance.

Masters Degree Program in Color Science—Offered through RIT's Munsell Color Science Laboratory, this program is designed to give students a broad exposure to the field of color and an opportunity to specialize in a particular area appropriate for their background and interest; this is the only graduate program devoted to this discipline in the U. S. The curriculum is designed for students whose undergraduate majors are in imaging science, photography, printing, textiles, physics, chemistry, psychology, physiology, graphic arts, fine arts, or any discipline pertaining to the quantative description of color. Candidates who do not have adequate undergraduate work in related sciences must make up foundation courses before matriculating into the program. The color science major provides graduate level study in both color science theory and its practical application. Color measurement, color appearance, and colorant formulation are stressed.

Contact: Colleen McCabe, Munsell Color Science Laboratory, Rochester Institute of Technology, P. O. Box 9887, Rochester, NY 14623-0887 (716) 475-7189.

State University of New York, New Paltz, NY

(The following three courses can earn Continuing Education Units.)

Crosslinked Polymers: Chemistry, Properties and Applications—March 18-20. The objectives of this course are to acquaint scientists with the latest developments in various aspects of crosslinked polymers. Subjects included are: introduction to crosslinked polymers and interpenetrating networks; chemistry of polyurethane polymers; applications and processing of polyurethanes; crosslinking of acrylic polymers; water-borne crosslinking polymers; applications of polymers in electronics; UV curing of polymers; unsaturated polyester resins—chemistry and properties; unsaturated polyester resins—processing and applications; epoxy resins—materials; epoxy resins—applications. Fee: $995.

Chemistry and Properties of High Performance Composites: Designed Especially for Chemists—March 28-30. The purpose of this course is to acquaint the practicing polymer chemist, engineer, and material scientist with the basic concepts of composites technology and give a practical working knowledge of the field. The course will emphasize selected disciplines, namely matrix chemistry, relationships between matrix resin properties and composite properties, processing technology and characterization/testing/evaluation techniques. Subjects included are: introduction to high performance composites; fibers and interfaces; mechanical characterization of neat resins and composites; epoxy resins used in high performance composites; thermoplastic resins used in high performance composites; other thermoset resins used in high performance composites; resin property—composite property relationships; toughness properties of neat resins and their composites; composite processing: thermoplastics; composite processing: thermosets; processing science—process monitoring; applications of composites in today's world. Fee: $995.

Fundamentals of Adhesion: Theory, Practice and Applications—Oct. 28-30. The purpose of this course is to present to chemists, engineers, material scientists and physicists the fundamentals of adhesion and the overviews of the latest progress in the science and technology of adhesion. Subjects included are: adhesion of solids derived from van der Waals forces; surface characterization in adhesion; new developments in structural adhesives; acid-base interactions, surface energetics and wettability; strength development of polymer-polymer interfaces; theory and practice of adhesion through silane coupling agents; physical properties and testing of polymeric adhesives and sealants; mechanics applied to adhesives, adhesive joints, and adhesive science; test methods for stress analysis of bonded structure; interface structure and bonding for thin film adhesion; high temperature polymers as adhesives. Fee: $995.

Contact: Dr. A. V. Patsis, Chemistry Dept., State University of New York, New Paltz, NY 12561 (914) 257-3800.

The Center for Professional Advancement, East Brunswick, NJ

Short Courses on Coatings Technology—Scheduled periodically. The Center from time to time offers courses on various coatings-related subjects. Upcoming presentations include: Environmental Risk Assessment of Chemicals (Mar. 18-20); and Wastewater Treatment in the Organic Chemicals and Pharmaceuticals Industries (Aug. 12-14).

Contact: General Information, The Center for Professional Advancement, P. O. Box 964, East Brunswick, NJ 08816 (201) 613-4535.

PHILADELPHIA

Drexel University, Philadelphia, PA

Short Courses on Polymer Science—Scheduled periodically, these one-day courses cover a variety of polymer-related topics. Lecturers are drawn from both industry and academia throughout the U.S. Recent series included presentations on: Mechanical Properties of Polymers and Composites; Application of Statistics to Polymer Problems; Polymeric Materials and Manufacturing Methods in the Automotive Industry; Epoxy Formulation; Reactive Compounding/Repolymerization; and Permeability and Diffusion in Polymers.

(Drexel University's Polymer Program includes undergraduate courses in the Materials Engineering, Chemistry, and Chemical Engineering curricula. Graduate courses are supplemented by the Mechanical Engineering Department offerings of several courses on composites involving polymeric materials.)

Contact: Dr. Roger D. Corneliussen, Director, Polymer Program, Materials Engineering, Drexel University, Philadelphia, PA 19104 (215) 895-2324.

Philadelphia College of Textiles and Science, Philadelphia, PA

Principles of Color Technology—This course is an introduction to the elements of color technology and color matching necessary in current industrial applications, and is oriented to people involved in the design, development, manufacture, production, and quality control of products of which color is a vital component. Included are demonstrations, problem sessions, and hands-on use of modern colorimetric instrumentation.

Contact: Dr. Mendel Trachtman, Chemistry Dept., Philadelphia College of Textiles and Science, Schoolhouse Lane and Henry Ave., Philadelphia, PA 19144 (215) 951-2870.

Lehigh University, Bethlehem, PA

Coatings-related courses are offered in the departments of Chemical Engineering (ChE), Chemistry (Chem) and Materials Science (Mat).

Physical Chemistry of Printing Inks (Chem 385)—Physical chemical mechanisms of printing processes; composition, dispersion processes for pigments rheology and printability of inks; color-matching; development of solventless inks and specialty inks.

Polymer Synthesis and Characterization Laboratory (ChE 388/Chem 388)—Techniques include: free radical and condensation polymerization; molecular weight distribution by gel chromatography; crystallinity and order by differential scanning calorimetry; pyrolysis and gas chromatography; dynamic mechanical and dielectric behavior; morphology and microscopy; surface properties.

Polymer Science (ChE 392/Chem 392)—Introduction to concepts of polymer science. Kinetics and mechanism of polymerization, synthesis and processing of polymers, characterization. Relationship of molecular conformation, structure and morphology to physical and mechanical properties.

Physical Polymer Science (ChE 393/Chem 393/Mat 343)—Structural and physical aspects of polymers (organic, inorganic, natural). Molecular and atomic basis for polymer properties and behavior. Characteristics of glassy, crystalline, and paracrystalline states (including viscoelastic and relaxation behavior) for single and multicomponent systems. Thermodynamics and kinetics of transition phenomena. Structure, morphology, and behavior.

Organic Polymer Science (ChE 394/Chem 394)—Organic chemistry of synthetic high polymers. Functionality and reactivity of monomers and polymers. Theory of stepgrowth and chaingrowth polymerization in homogeneous and heterogeneous media. Polymerization by addition, elimination, substitution and coupling reactions. Ionic free-radical and coordinate catalysis.

Colloid and Surface Chemistry (Chem 395)—Physical chemistry of everyday phenomena. Intermolecular forces and electrostatic phenomena at interfaces, boundry tensions and films at interfaces, boundary tensions and films at interfaces, mass and charge transport in colloidal suspensions, electrostatic and London forces in disperse systems, gas absorption and heterogeneous catalysis.

Engineering Behavior of Polymers (ChE 482/Chem 482/Mat 482)—A treatment of the mechanical behavior of polymers. Characterization of experimentally observed viscoelastic response of polymeric solids with the aid of mechanical model analogs. Topics include time-temperature superposition, experimental characterization of large deformation and fracture processes, polymer adhesion, and the effects of fillers, plasticizers, moisture and aging on mechanical behavior.

Emulsion Polymers (ChE 483/Chem 483)—Examination of fundamental concepts important in the manufacture, characterization, and application of polymer latexes. Topics covered include colloidal stability, polymerization mechanisms and kinetics, reactor design, characterization of particle surfaces, latex rheology, morphology considerations, polymerization with functional groups, film formation and various application problems.

Crystalline Polymers (ChE 484/Chem 484)—An in-depth treatment of the morphology and behavior of both polymer single crystals and bulk crystallized systems. Emphasis is placed on the relationship between basic crystal physics, thermal and annealing history, orientation and resulting properties. A detailed discussion of the thermodynamics and kinetics of transition phenomena and a brief treatment of hydrodynamic properties and their relationship to crystallization and processing properties are included.

Polymer Blends and Composites (ChE 485/Chem 485)—An intensive study of the synthesis, morphology, and mechanical behavior of polymer blends and composites. Mechanical blends, block and graft copolymers, interpenetrating polymer networks, polymer impregnated concrete, and fiber and particulate reinforced polymers are emphasized.

Polymer Processing (ChE 486)—Application of fundamental principles of mechanics, fluid dynamics and heat transfer to the analysis of a wide variety of polymer flow processes. A brief survey of the rheological behavior of polymers is also included. Topics include pressurization, pumping, die forming, calendering, coating, molding, fiber spinning and elastic phenomena.

Topics in Colloid and Surface Chemistry (Chem 487)—Applications of colloid chemistry, special topics in surface chemistry. Lectures and seminar. May be repeated for credit as different topics are covered.

Topics in Polymer Science (ChE 492/Chem 492)—Intensive study of topic selected from areas of current research interest such as morphology and mechanical behavior, thermodynamics and kinetics of crystallization, new analytical techniques, molecular weight distribution, non-Newtonian flow behavior, second-order transition phenomena, novel polymer structures. Credit above three hours is granted only when different material is covered.

Advances in Emulsion Polymerization and Latex Technology—June 3-7. This short course is an in-depth study of the synthesis and properties of high polymer latexes, and is designed for engineers, chemists, other scientists and managers who are actively involved in emulsion work and for those who wish to develop expertise in the area. Subject matter includes balance of theory and applications, as well as a balance between chemical and physical problems. Fee: $800 for entire week, or $225 per day for any part.

Contact: Dr. Mohamed S. El-Aasser, Emulsion Polymers Institute, Lehigh University, 111 Research Drive, Bethlehem, PA 18015 (215) 758-3082.

Corrosion Control by Coatings—Sept. This annual course is aimed at those concerned with protective coatings research and technology, and also provides demonstrations of basic laboratory techniques. Opportunities are available for individualized instruction.

Contact: Dr. Richard Granata, Zettlemoyer Center for Surface Studies, Sinclair Lab #7, Lehigh University, Bethlehem, PA 18015 (215) 758-3574.

Northeastern Christian Junior College, Villanova, PA

Introduction to Coatings Technology—Feb. to May. This 12-week evening course (2 hours per week) is designed for new coatings formulators, as well as sales and marketing personnel in coatings and allied industries. Focus is on six basic coatings formulations and the formulation technology, raw materials, application, and performance of each. Enrollment is limited. Fee: Philadelphia Society members, $300; non-members, $350.

Course is presented in conjunction with Lehigh University; successful course completion earns 3.6 CEU credits; course may be qualified for credit at another institution by prior arrangements.

Contact: Dr. Richard Granata, Zettlemoyer Center for Surface Studies, Sinclair Lab #7, Lehigh University, Bethlehem, PA 18015 (215) 758-3574.

TORONTO

George Brown College of Applied Arts and Technology, Toronto, Canada

Evening and Saturday part-time courses in coatings and plastics technology are offered at the St. James Campus, convenient to downtown Toronto.

The courses, which are approved and certified by the College and the Toronto Society for Coatings Technology, are designed to be taken separately. Credits may be accumulated toward the Chemical Technician - Coatings Certificate.

Polymer Chemistry (CHEM 2101)—This 15-week evening course (3 hours per week) introduces basic concepts of polymer science and discusses variables affecting properties of polymers.

Topics covered include: polymer classification; primary and secondary forces; theory of functionality; molecular weight and its distribution; configurations and conformations of polymer chains; morphology; polymer stabilization and degradation; polymer solutions; and solvent-pigment-binder interactions.

Resins "C" (COAT 2051)—This 15-week, 3 hours per week, course is a study of raw materials, manufactuirng methods, chemistry, film formation, properties and uses of lacquer and hydrocarbon, phenolic, amino, silicone and water-borne resins.

Communications (COMM 901)—This is a 14-week course (3 hours per week). Prerequisite is Grade 12 English or equivalent. Covered are study skills, essential grammar and punctuation skills, effective organization of ideas in paragraph and short essay forms, proofreading techniques, research skills, introductory report writing, and short oral presentations.

Business Management I (BUS 900A)—This is a 14-week course (3 hours per week), focusing on corporate structures, company planning, decision making and policy formulations, organizing and staffing, planning and controlling communications, and the various levels of management.

Communications II (COMM 902)—This is a 14-week course (3 hours per week). Prerequisite is Communications I. The student is taken through a step-by-step process of writing either a business or technical report. Included are research, organization, outlining, bibliography, and summary/abstract. Emphasized are basic rules of technical writing, grammar, and layout.

Business Management II (BUS 900B)—This is a 14-week (3 hours per week) course. Topics covered include: production, marketing, financial, and personnel functions; business and government; international corporations, current and future concerns. Case studies are presented.

Introduction to Microcomputer Programming (PRGM 9251)—This is 10-week (3 hours per week) course which covers the following topics: introduction to the microcomputer, hardware, software, terminology, and the language BASIC; writing, running, saving, and printing programs; program development, including documentation, editing, input and output techniques, decision-making and branching; arrays and READ/DATA statements.

Resins "A" (COAT 2041)—(Polyesters, Alkyds, Epoxies). This is a 15-week course (3 hours per week) which covers chemical structure of raw materials, formulating resins to achieve specified properties, additives, condensation-addition polymerization, curing mechanisms, compounding, patton K factor, properties of uncured and cured resins, advantages and disadvantages of each resin, applications in coatings and related industries.

The following laboratory courses are offered:

Resins "A" Laboratory (COAT 2141)—Prequisite COAT 2041 or equivalent. Quality control, curing, properties of unsaturated polyester, alkyds, and epoxy resins. Enrollment limited.

Resins "C" Laboratory (COAT 2151)—Prerequisite COAT 2051 or equivalent. Quality control, curing, film formation, properties of: lacquer, hydrocarbon, phenolic, amino, silicone and water-borne resins. Enrollment limited.

Paint Flow and Pigment Dispersion Laboratory (COAT 2161)—Measurement of rheological properties of water-and solvent borne systems using rheological additives with viscometers. Evaluation of factors affecting viscosity, brushing, leveling, settling. Dispersion of pigments using various dispersion techniques. Assessment of pigment dispersion in mill-base and let-down stage.

Polymer Chemistry Laboratory (CHEM 2201)—Prerequisite Chem 210 or equivalent. Synthesis of commercially available polymers; performing quality control tests. Determination of molecular weight and identification of various polymers.

Contact: Peter Rodak, George Brown College of Applied Arts and Technology, P. O. Box 1015, Station B, Toronto, Ontario M5T 2T9, Canada (416) 967-1212 (Ext. 3376).

University of Waterloo, Waterloo, Canada

Graduate Program in Polymers—Students in this program may enroll in Chemistry or Chemical Engineering, but course requirements are identical. Graduate courses include: Principles of Polymer Science; Polymerization Kinetics; Physical Properties of Polymers; Characterization of Polymers with Regard to Structure and Morphology; Polmerization and Polymer Reactions; Applications of Polymer Principles in Coatings; and Polymer Blends and Reactive Extrusion.

Contact: Dr. Alfred Rudin, Professor of Chemistry, University of Waterloo, Waterloo, Ontario N21 3G1, Canada (519) 885-1211.

DALLAS

Kilgore College, Kilgore, TX

Atmospheric Corrosion Control, Corrosion Tech 2410—Jan. to May. This 15-week course is part of a two-year course at Kilgore, and is one of five courses in corrosion technology leading to an Associate of Applied Science Degree. A study of atmospheric corrosion control, including paints and coatings and surface preparation and application, the course includes three lecture and three lab hours each week. Prerequisite for this course is Corrosion Technology 1310, Introduction to Corrosion.

Contact: Bobby Cargill, Counselor, Kilgore Collge, 1100 Broadway Blvd., Kilgore, TX 75662 (214) 983-8184.

HOUSTON

National Association of Corrosion Engineers, Houston, TX

Short Courses on Corrosion Control—These special courses, of varying lengths, are held at regional locations throughout the year. Recent series included presentations on: Corrosion Fundamentals; Cathodic Protection; Protective Coatings and Linings; Basic, Intermediate, and Advanced Coating Inspection; and Materials Selection and Design.

Contact: NACE Education and Training, National Association of Corrosion Engineers, P. O. Box 218340, Houston, TX 77218 (713) 492-0535.

ST. LOUIS

University of Missouri-Rolla, Rolla, MO

Chemistry Curriculum (With Specialization in Polymer and Coatings Science)—This program encompasses the standard chemistry curriculum, plus courses in coatings, surface, and polymer chemis-

try. It is designed to provde undergraduate training in coatings science and technology.

Students seeking coatings science specialization are encouraged to seek summer employment at a coatings-oriented firm, as well as cooperative work-study programs with such firms. Students also participate in a senior research project in polymer and coatings science. This leads to the B.S. degree in Chemistry. M.S. and Ph.D. degree programs are also available for graduate studies.

Tuition scholarships supported by the Federation of Societies for Coatings Technology at University of Missouri-Rolla are available for undergraduate students interested in this curriculum.

Contact: Harvest Collier, Chemistry Dept., University of Missouri-Rolla, Rolla, MO 65401 (314) 341-4419.

Introductory Short Course—The Basic Composition of Coatings—Mar. 11-15 and Sept. 9-13. Offered twice a year, this is a fundamental five-day course for anyone interested in learning about coatings science, with basic information on the materials used, their manufacture, and testing. Many types of paint are studied to show: differences in composition; how materials used in coatings are identified; formulation procedures; and quality control tests. Discussion of the chemistry of coatings includes polymer chemistry and analytical chemistry; also covered are various types of instrumentation. Spring fee: $695.

Introductory Short Course—Paint Formulation—Mar. 25-29 and Oct. 21-25. This five-day course is held in the Spring and Fall, and covers basic fundamental concepts of coatings formulation. Lectures and laboratory sessions explain and demonstrate through practice, basic raw materials used: their influence on the performance characteristics of finished coatings; manufacture and testing of coatings in the laboratory to meet the stated requirements of the job to be done with a minimum of inventory complication; limitations of plant production equipment and the variables that can be introduced when a coating is moved from the lab to the plant; simple cost accounting and systems for reducing variables in screening series. Methods of calculating formulas that assure compliance with federal regulations are also covered. Enrollment is limited. Spring fee: $795.

Basic Coatings for Sales and Marketing Personnel—July 17-19. This three-day course is designed to aid sales and marketing personnel in a better understanding of the composition of coatings. In addition, the relationships between composition and performance characteristics are emphasized. The customer's specifications and testing techniques are related to formulation criteria. The beginning sales person should find the evening open forum on sales very useful. This course will benefit paint manufacturers as well as raw materials personnel. The 1991 course will be held at the St. Louis Airport Marriott Hotel. Fee: $525.

For all of the above University of Missouri-Rolla Short Courses contact: Michael R. Van De Mark, Director, Coatings and Polymer Science Program, Dept. of Chemistry, 142 Schrenk Hall, University of Missouri-Rolla, Rolla, MO 65401-0249 (314) 341-4419 or 341-4420.

SOUTHERN

Clemson University, Clemson, SC

Coated Fabrics—This two-day course is designed to provide a broader and more up-to-date understanding of the vital factors influencing the development, production, and marketing of coated fabrics, including those presently in use, and some still on the drawing board. Emphasis is placed on the underlying principles behind technical developments ranging from fibers all the way through markets, including: textile substrates; coating applications; physical and chemical nature of polymers and prepolymers; production of coatings; and physical testing of end-products.

Contact: J. Richard Aspland, School of Textiles, Clemson University, Clemson, SC 29634-1307 (803) 656-5953.

Holiday Inn-Airport North, Atlanta, GA

Estimating for Painting Contractors and Maintenance Engineers—Apr. 8-10. This comprehensive three-day short course is being offered twice this year (also presented Mar. 18-20, in Chicago) by the Foundation for Chemical Research and covers blueprint reading, specifications, quantity take-offs, pricing structures and problem solving. The class works from actual plans in as near a real-life situation as possible. The instructor for this course is Len A. Hijuelos. He has specialized in estimating, primarily for industrial work, and has assisted in the development of training programs, and new curriculum for the painting industry. Fee: $545.

Contact: Suzan Yelek, Estimating, Foundation for Chemical Research, P. O. Box 1401, Rolla, MO 65401 (314) 341-3406 or 364-5880.

University of Southern Mississippi, Hattiesburg, MS

Surface Coatings (PSC 470,470L)—Sept. to Dec. This 4 hour lecture, 1 hour lab course is designed for students with a background in organic and physical chemistry. It is taught at the senior undergraduate/graduate level and includes chemistry and physics of binders, pigments, solvents and additives for surface coatings. Pigment dispersion, coatings formulation, surface chemistry, quality control, testing of raw materials and products, application methods, corrosion, and coatings specifications are included.

Organic Polymer Chemistry I and II (PSC 301, 302)—Sept. to May. This course (3 hour lecture, 1 hour lab each term) is a systematic study of polymers, including polymer formation techniques, kinetics, and properties, with emphasis on step and addition polymerization, and stereoregular polymerization.

Polymer Techniques (PSC 341L, 342L)—Sept. to May. Laboratory methods of polymer synthesis, structural determination, and characterization (2 hour lab each).

Polymer Rheology (PSC 360)—Sept. to Dec. Theory and practice of fluid flow are emphasized (3 hour lecture).

Polymer Processing I (PSC 361, 361L)—Jan. to May. Extrusion technology, reaction injection molding, blown films, and wire coating are emphasized (3 hour lecture, 2 hour lab).

Physical Chemistry of Polymers I and II (PSC 401, 402)—Sept. to May. Polymer structure, chain conformation, solution properties, themo-dynamics, fractionation, molecular weight measurement, instrumental analysis of polymers, morphology, structure-property relations are taught (3 hour lecture).

Introduction to Macromolecules (PSC 412)—June to Aug. An introduction to the chemistry and physics of natural and synthetic high polymers (3 hour lecture).

Polymer Kinetics (PSC 480)—Jan. to May. Introduction to polymerization kinetics and reactor design (3 hour lecture).

Undergraduate Research (PSC 490, 490L, 491, 491L)—Individual research. Prospectus is prepared and research plan is executed with final status report required (1 hour lecture, 3 hour lab each term).

Graduate Organic Polymer Chemistry I, II, and III (PSC 701, 702, 703)—Sept. to May. An in-depth study of polymer forming reac-

tions, their scope and limitations. Relationships between molecular weight, polymer structure, and physical properties of polymers are established (3 hour lecture each).

Graduate Polymer Physical Science I, II, and III (PSC 710, 711, 712)—Sept. to May. Includes such topics as light scattering, end group analysis, osmometry, polymer fractionation, NMR, I.R., U.V., and visible spectroscopy, thermoanalytical evaluation, mass spectrometry, polymer chain conformation, macromolecular solutions, molecular weight distribution, morphology, rheology, structure-property relations, and kinetics of addition-, condensation-, and copolymerization (3 hour lecture each).

Physical Properties of Macromolecular Solids (PSC 810)—Sept. to Dec. Advanced study of glassy and crystalline physical state of macromolecular solids emphasizing the influence of morphological structure (2 hour lecture).

Polymer Physics (PSC 811)—Sept. to Dec. Study of polymer conformation, phenomenological and molecular theories of polymer relaxation and diffusion in polymers (3 hour lecture).

Conformational Analysis (PSC 812)—Sept. to Dec. Study of molecular interactions that control polymer conformation. Molecular modeling in material design (2 hour lecture).

Tuition scholarships supported by the Federation of Societies for Coatings Technology at the University of Southern Mississippi are available for undergraduate students interested in this curriculum.

(The following short courses, sponsored by University of Southern Mississippi and the Southern Society for Coatings Technology, are being held in conjunction with the annual Water-Borne, Higher Solids, and Powder Coatings Symposium, Feb. 6-8, at the Hyatt Regency Hotel, New Orleans, LA.)

Short Course on Water-Soluble Polymers—Feb. 4-5. Organized for industrial scientists, this program emphasizes synthesis, structural methods of identification, solution properties, and rheological behavior. Lectures are designed to clearly delineate structure/property relationships and to convey appropriate methods for technological development. Fee: $495.

Short Course on Modern Coatings Technology—Feb. 4-5. This course is intended to provide update for individuals with managerial responsibilities for coatings development, as well as scientific personnel who have responsibility for designing, formulating, manufacturing, and testing coatings. Lectures are designed to clearly delineate formulation/performance relationships, and to convey appropriate methods for technological development of superior yet cost effective coatings. Topics covered include polymer design and selection, additives, pigment selection for color matching, hiding power at minimal cost, extender pigments, and computer formulation. Fee: $495.

Contact: Dr. Shelby F. Thames, Dept. of Polymer Science, University of Southern Mississippi, P.O. Box 10076, Southern Station, Hattiesburg, MS 39406 (601) 266-4868.

WESTERN

GOLDEN GATE

Various Locations in Oakland/San Francisco Area

Introduction to Coatings Technology—Sept. to Feb. This evening course, sponsored by the Golden Gate Society and the Golden Gate Paint and Coatings Association, is presented once a week for 21 weeks. Each session is 2-3 hours. The schedule consists of a class lecture the first week, guest speaker the second week, and plant tour the third week. That sequence repeats throughout the course. Class lectures deal with the "basics" including film formation, vehicles, pigments, additives, and calculations. Guest speakers cover topics of current interest, including regulations and compliance, safety, quality control, computer application, waste disposal and research. The plant tours are field trips to various industry facilities in the Bay Area.

Contact: Ted Favata, 360 Lake Mendocino Drive, Ukiah, CA 95482 (707) 462-3023.

University of California, Berkeley, CA

Getting into Compliance with Environmental Regulations for Paints and Coatings—June 4-7. This two -day short course presents information about the most important consequences of air pollution regulations that affect the paint and coatings industry. Included is a thorough review of various coatings-related regulations with which participants should be familiar, e.g., State Implementation Plans (SIPs), New Source Performance Standards (NSPS), New Source Review (NSR), and the relationships between the federal EPA and state and local air quality districts. Enforcement procedures and typical fines are covered. Procedures for calculating VOCs for over 10 different scenarios are provided, including calculations for water-borne and exempt solvent coatings. Several examples are provided on how to calculate an alternative emission control plan. Then, a variety of current coating technologies are discussed which offer compliance capability. Fee: $795.

Contact: Dr. Richard V. Tsina, Continuing Education in Engineering, University of California University Extension, 2223 Fulton St., Berkeley, CA 94720 (415) 642-4151.

LOS ANGELES

California Polytechnic State University, San Luis Obispo, CA

A B.S. degree program in Polymer Chemistry with Concentration in Coatings is offered.

The following chemistry courses are included in the concentration:

Polymers and Coatings I (Chem 444)—Polymer nomenclature and definitions; overview of polymer synthesis and structure; molecular weight distributions and averages and their determination; thermal properties of polymers, glass transition, thermal analysis; mechanical properties, dynamic and static mechanical analysis; polymer crystallinity; thermodynamics of polymer solutions, dynamics of polymer chains, interchain forces; viscoelastic properties and their measurement; polymer rheology; NMR, IR, Raman, UV/VIS spectroscopic analysis; current topics in polymer chemistry; special applications to coatings. Three one-hour lectures per week.

Polymers and Coatings II (Chem 445)—Polymerization methods and mechanisms; chain growth, step growth, and ring opening polymerizations; chemistry of catalysts and inhibitors; copolymerization;

kinetics of polymerization; use of representative types of polymers; film formation; structure and properties of acrylics, vinyls, polyesters, alkyds, epoxies, urethanes, phenolics, hydrocarbons, and cellulosics, raw materials in coatings and formulation techniques. Three one-hour lectures per week.

Surface Chemistry of Materials (Chem 446)—Surface energy; capillarity; solid and liquid interface; adsorption; surface areas of solids; contact angles and wetting; friction, lubrication and adhesion; relationship or surface to bulk properties of materials; applications. Three one-hour lectures per week.

Polymers and Coatings Lab I (Chem 447)—Synthesis and characterization of polymers; experimental techniques of step-growth, chain-growth, and ring opening polymerization; experimental methods of molecular weight determination including light scattering, osmometry, viscometry, and gel-permeation chromatography; experimental methods of thermal analysis; NMR, infrared, Raman, and UV/VIS spectroscopic analysis; mechanical analysis. Two three-hour labs per week.

Polymers and Coatings Lab II (Chem 448)—Experimental techniques of producing and characterizing coatings; compounding and formulating modern protective coatings; modern methods of testing protective coatings; surface preparation techniques. Two three-hour labs per week.

Internship in Polymers and Coatings (Chem 449)—Students spend three to six months with an approved polymers and coatings firm engaged in production, development, research, or related business. Students will develop and apply research, production, and managerial skills.

The following course, from the Materials Science Department, is also included in the concentration:

Materials Engineering (Met 306)—Physical and mechanical properties of materials including metals, alloys, ceramics, insulating materials, semiconductors, and polymers; equilibrium diagrams; heat treatments, materials selection, and corrosion phenomena. Three one-hour lectures per week.

Contact: Dr. Dane Jones, Chemistry Dept., California Polytechnic State University, San Luis Obispo, CA 93407 (805) 756-2528.

Rosewood Park Center, Commerce, CA

Paint Technology—Sept. to June. Introductory course, offered by the Los Angeles Society for Coatings Technology, which concentrates on raw materials, including pigments, various classes of vehicles, and solvents. An introduction to coating formulation is also included. Students who satisfactorily complete the full course are awarded certificates.

Contact: Frank Peters, Dunn-Edwards Corp., 4885 E. 52nd Place, Los Angeles, CA 90040 (213) 771-3330 (Ext. 341).

University of Southern California, Los Angeles, CA

Chemical Engineering 472—Sept. to Dec. This 16-week upper division course in polymer science and engineering deals with preparation, characterization and properties of synthetic polymers.

Contact: Ron Salovey, Dept. of Chemical Engineering, MC 1211, University of Southern California, Los Angeles, CA 90089 (213) 740-2073.

Chemical Engineering 475—Sept. to Dec. This 16-week course in physical properties of polymers studies mechanical, electrical, and optical properties of polymers, poly-blends and polymer composites.

Contact: W. V. Chang, Department of Chemical Engineering, University of Southern California, Los Angeles, CA 90089 (213) 740-2072.

Chemical Engineering 474L—Jan. to May. This 16-week laboratory course in polymer science and engineering features experimental methods for the preparation, characterization, and properties of synthetic polymers.

Contact: Ron Salovey, Dept. of Chemical Engineering, University of Southern California, Los Angeles, CA 90089 (213) 740-2073.

Chemical Engineering 478—Jan. to May. This is an upper division course which examines classes of polymers of commercial interest, their structure, properties, and application.

Contact: S. H. Goodman, Dept. of Chemical Engineering, University of Southern California, Los Angeles, CA 90089 (213) 616-6030.

Chemical Engineering 548—Jan. to May. This graduate class considers the flow of liquid and solid systems.

Contact: Ron Salovey, Dept. of Chemical Engineering, University of Southern California, Los Angeles, CA 90089 (213) 740-2073.

PACIFIC NORTHWEST

British Columbia Institute of Technology, Burnaby, Canada

Modern Coating Resins I & II—Offered during the winter session, this evening course is sponsored by the Vancouver Section of the Pacific Northwest Society for Coatings Technology and the British Columbia Paint Manufacturers' Association. Fee: $185 (Canadian).

Contact: Dave A. Pasin, Gibson Paint, 12255 King George Hwy. (112th Ave.), Surrey, B.C., V3V 3K9, Canada (604) 580-1575.

Kwantlen College, Vancouver, Canada

Introduction to Paint Technology—Jan. to Apr. Sponsored by the Vancouver Section of the Pacific Northwest Society for Coatings Technology and the British Columbia Paint Manufacturers' Association, this 12-week evening course (3 hours per week) provides a background in surface coatings technology and is ideally suited for front line sales staff, production personnel, applicators, technologists, engineers, and architects. Topics covered include: composition of paints and coatings and their effects on performance; coatings problems; basic formulation; manufacturing and quality control; corrosion and its control by coatings; and modern and high-performance coatings. Course also includes plant tours and hands-on lab testing. Fee: $185 (Canadian).

Contact: Dave A. Pasin, Gibson Paint, 12255 King George Hwy. (112th Ave.), Surrey, B.C., V3V 3K9, Canada (604) 580-1575.

Symposia, Seminars, Workshops, and Exhibits

CENTRAL

CHICAGO

Chicago-Area Locations

Pittsburgh Conference and Exposition on Analytical Chemistry and Applied Spectroscopy—Mar. 4-8. Annual event sponsored by Analytical Chemists of Pittsburgh and the Spectroscopy Society of Pittsburgh. Site for 1991 is Chicago's McCormick Place.

Contact: Pittsburgh Conference, 300 Penn Center Blvd., Suite 332, Pittsburgh, PA 15235.

Seminars on Statistical Process Control for the Coatings Industry—Level I (Mar. 11-12); Level I-A (Mar. 13 and Mar. 18); Level II (Mar. 19-21). These seminars, sponsored by the Federation of Societies for Coatings Technology, will be held at Chicago O'Hare Marriott, and are designed to introduce SPC methods to personnel working in coatings manufacturing and related areas (e.g., chemicals, pigments), which employ a batch process.

In Level I, focus is on identifying appropriate product and machine variables to measure, plotting and interpreting control charts, evaluating process capability, and implementing an SPC system. Programming emphasizes Dr. W. Edwards Deming's concepts which apply statistics to production samples to reduce variation and minimize waste, and covers mathematics of variability, system and special causes, the normal distribution, histograms, control sampling to make machine and process adjustments.

Level I-A focuses on the value of a broad-based quality effort—one which encompasses not only production, but all aspects of providing a product and/or service, to achieve a Total Quality Management (TQM) system. Programming is designed to provide participants with the ability to identify and understand each component of a TQM system, understand how SPC is a tool for implementing some components of TQM, and develop a plan for implementing a TQM system in their company and execute that plan. Although SPC activities make up only a portion of the components in TQM, they are the more difficult to implement and are given special emphasis.

Level II stresses the practical application of statistical techniques to respond to manufacturing, research and management concerns to improve first run capability. Programming concentrates on understanding when to use a particular technique and how to interpret and use the results to improve product quality (e.g., how to formulate the question, which statistical procedure should be employed, and what the results mean), which must be understood to properly use statistical procedures as a tool. Registrants should have a basic understanding of Statistical Process Control (attendance at the Level I seminars, or equivalent) and a working knowledge of basic algebra.

Contact: Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422-2350 (215) 940-0777.

Surface Coating '91—Apr. 15-18. Combination of technical presentations, workshops, and exhibits are offered. Site is Indian Lakes Resort, near O'Hare International Airport.

Contact: Chemical Coaters Association, 8072 Beechmont Ave., Cincinnati, OH (513) 474-2030.

Management Development Seminar—May 2. Sponsored jointly by the Chicago Society for Coatings Technology and Chicago Paint and Coatings Association, programming is intended to enrich the management skills of managers and management-minded individuals in the coatings industry.

Contact: John Duvaney, 5 Ogden Court, Box 1051, Ogden Dunes, IN 46368 (219) 763-3807.

American Oil Chemists' Society Annual Meeting and Expo—May 12-15. Held annually, the 1991 event will be at Chicago's Marriott Hotel.

Contact: Myra Barenberg, AOCS, P.O. Box 3489, Champaign, IL 61826-3489.

Paint/Con '91—May 14-16. Conference and exhibits, sponsored by Industrial Finishing magazine. The 1991 event will be held at O'Hare Expo Center (located near Chicago's O'Hare International Airport).

Contact: PEMCO, 2400 E. Devon Ave., Suite 205, Des Plaines, IL 60018 (708) 299-3131.

National Decorating Products Convention and Show—Nov. 22-24. This annual event will be held in 1991 at Chicago's McCormick Place, and will feature seminars, workshops, clinics, and panel discussions on various aspects of paint and wall coverings, in addition to exhibits.

Contact: National Decorating Products Association, 1500 N. Lindbergh Blvd., St. Louis, MO 63132 (314) 991-3470.

Spray Painting Seminars—Sponsored by Binks Manufacturing Co., these five-day events are conducted periodically at the firm's facilities: Franklin Park, IL; Pine Brook, NJ; Livonia, MI; and Norcross, GA. They are designed to help participants properly select, operate, and maintain current spray finishing equipment, and are for both the experienced operator and the novice.

Contact: Training Div., Binks Manufacturing Co., 9201 W. Belmont Ave., Franklin Park, IL 60131 (312) 671-3000.

CLEVELAND

B.F. Goodrich R&D Center, Brecksville, OH

Annual Coatings Symposium—June 6. Sponsored by Cleveland Society for Coatings Technology, the 1991 event will present "Additive Technology Used in Water-Based, High Solids, and Powder Coatings." Speakers will discuss the role of additives in coatings systems designed to reduce VOC.

Contact: DeVilla Moncrief, Sherwin-Williams Co., 601 Canal Rd., Cleveland, OH 44113 (216) 566-2921.

DETROIT

Detroit-Area Locations

Annual Symposium on Future of Coatings Under Study (FOCUS)—Apr. 17. Held each Spring under sponsorship of Detroit Society for Coatings Technology, theme of 1991 event is "Complying with the DNR While Remaining Solvent." Emphasis will be on high solids resin technology, compliant solvents, reactive diluents, water-borne

coatings, powder coatings, and transfer efficiency. Site is Mercy College, Detroit MI.

Contact: Dr. Valerie Gunn, FOCUS Chairperson, Akzo Coatings, Inc., P.O. Box 7062, Troy, MI 48007-7062 (313) 637-8521.

Advanced Coatings Technology Conference—June. Event will provide a comprehensive overview of coatings technology for the automotive and durable goods manufacturing industries. Special emphasis will be on the focused education of personnel engaged in materials, manufacturing, and product design engineering, as well as on state-of-the-art developments in all industrial coatings technologies and their application in a manufacturing environment. Critical issues of environmental compliance, safety, and quality assurance will also be addressed. Programming for the Conference, which is part of Materials Week (sponsored by the Engineering Society of Detroit), is being developed by members of the Detroit Society for Coatings Technology. The Conference will be held at the Engineering Society of Detroit, Detroit, MI.

Contact: Gabriel J. Gabriel, Mercury Paint Co., 14300 Schaefer Highway, Detroit, MI 48227 (313) 491-5650.

NORTHWESTERN

Minneapolis/St. Paul-Area Locations

Annual Coatings Symposium—Mar. 5. Sponsored by Northwestern Society for Coatings Technology, topics chosen are of interest to management, technical managers, and lab personnel in the coatings and related industries. This year's event is titled, "Coatings—A Global Perspective," and will focus on domestic and international issues in today's Coatings Market.

Contact: Brenda Eklund, Valspar Corp., 1101 3rd St., Minneapolis, MN 55415 (612) 375-7987.

EASTERN

BALTIMORE

Washington, DC-Area Locations

Washington Paint Technical Group Annual Symposium—Apr. 9-10. The 1991 Symposium, which has its theme, "Environmental Regulations: A New Ball Game," is scheduled for the Ramada Hotel—Tysons Corner, Falls Church, VA.

Contact: John Peart, Federal Highway Administration (703) 285-2329.

Dry Color Manufacturers' Association Annual Meeting—June 16-19. The 1991 event will be held at The Greenbrier, White Sulphur Springs, WV.

Contact: DCMA, 300 N. Washington St., Alexandria, VA 22320 (703) 684-4044..

CINCINNATI-DAYTON-INDIANAPOLIS-COLUMBUS

Convention Center, Cincinnati, OH

Corrosion '91—Mar. 11-15. Annual conference and exhibition of the National Association of Corrosion Engineers. Featured are technical symposia of more than 450 papers, along with exhibits of supplier firms.

Contact: National Association of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218 (713) 492-0535.

PITTSBURGH

Pittsburgh-Area Locations

Conference on Coatings Evaluation and Durability—Apr. 29-May 3. Sponsored by the Steel Structures Painting Council, ASTM Committee D-1, National Institute of Standards and Technology, Naval Civil Engineering Laboratory, Paint Research Association (UK), and National Association of Corrosion Engineers, the conference will assess state of the technology in performance evaluation of coatings, to set directions for establishing an industry-wide consensus on standard methods for testing coatings, characterizing their condition, using statistics to interpret test data, and reporting results. The event will be held at Pittsburgh's Westin William Penn Hotel.

Contact: Rose Mary Surgent, Meetings Manager, Steel Structures Painting Council, 4400 Fifth Ave., Pittsburgh, PA 15213-2683 (412) 268-3326.

National Thermal Spray Conference/Exposition—May 6-10. Sponsored by ASM International, the event will be held at Pittsburgh's David H. Lawrence Convention Center.

Contact: ASM International, Materials Park, OH 44073 (216) 338-5151.

International Bridge Conference—June. This annual event is sponsored by the Engineers' Society of Western Pennsylvania.

Contact: International Bridge Conference, c/o Engineers' Society of Western Pennsylvania, The Pittsburgh Engineers' Bldg., 337 Fourth Ave., Pittsburgh, PA 15222.

Coatings Inspection Courses—Offered by KTA-Tator, Inc. at their Pittsburgh facilities, this series is comprised of five courses designed to train or refresh coating personnel in the fundamentals of coatings technology, surface preparation, application, and inspection. The course includes: Bridge and Highway Structures; Level II Industrial Maintenance; Inspection of High Performance Coatings; Inspection of Coatings and Linings for Immersion Service; and Maintenance Industrial Painting Practices.

Contact: William Corbett, KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275 (412) 788-1300.

NORTHEASTERN

NEW YORK

New York/New Jersey-Area Locations

Fall Meeting of American Chemical Society—Aug. 25-30. One of two annual ACS national meetings (Spring meeting will be in Atlanta, GA, Apr. 14-19), featuring technical sessions and exhibits. Division of Polymeric Materials Science and Engineering sponsors presentations for each of these events on a variety of coatings-related subjects. The Fall meeting will be held in New York City.

Contact: American Chemical Society, Dept. of Meetings & Divisional Activities, 1155 16th St., NW, Washington, DC 20036 (202) 872-4396.

PHILADELPHIA

Philadelphia-Area Locations

Society of Vacuum Coaters Annual Technical Conference—Mar. 17-22. The 1991 event will be held at Adam's Mark Hotel, Philadelphia, PA.

Contact: Donald Mattox, Society of Vacuum Coaters, Albuquerque, NM (505) 298-7624.

Seminar on Formulating for the Future—May 13-14. Sponsored by the Federation of Societies for Coatings Technology, programming will focus on new water-borne resin and additive technology that is available (or will be in the near future) to the coatings formulator. Included are recent developments in rheological modifiers, defoamers, dispersants, surfactants, heavy metal free-corrosion-inhibitive pigments, opacifying pigment and biocides. Seminar will be held at Philadelphia's Society Hill Sheraton Hotel.

Contact: Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422-2350 (215) 940-0777.

Product Quality Management Seminar Series—Offered by DuPont Quality Management Services, these seminars are presented at various locations in The U.S. Included are the following seminars: "Strategy of Experimentation" (3 days); "Strategy of Formulations Developments" (3 days); "Experimentation with Robust Product Design" (3 days); "Leadership of Continuous Improvement" (1 day); "Fundamentals of Continuous Improvement" (1 day); "Solving Tough Quality Problems" (2 days); "Statistical Process Control" (4 days); and "Focus on Data" (3 days). Also, seminar, "Quality Technology for Managers" can be arranged for on-site presentation for groups of up to 40.

Contact: Marg Frank, DuPont Quality Management Services, Linden Park, Room 468, P.O. Box 6091, Newark, DE 19714-6091.

TORONTO

Toronto-Area Locations

Coatings Technology Seminar—Mar. 4. Sponsored by Toronto Society for Coatings Technology, programming will be geared to theme of "The Environment."

Contact: Dennis Johnston, Baylex Technologies Inc., 1932 Mattawa Ave., Mississauga, Ontario L4X 1K1, Canada (416) 625-6110.

Surf/Fin '91—June 24-27. Annual technical conference and exhibit of surface finishing, which will be held at Metro Toronto Convention Centre.

Contact: American Electroplaters and Surface Finishers Society, 12644 Research Parkway, Orlando, FL 32826 (407) 281-6441.

FSCT Annual Meeting and Paint Industries' Show—Nov. 4-6. Sponsored by Federation of Societies for Coatings Technology, the event features three days of technical sessions and the exhibits of more than 275 supplier firms. Theme is "The International Coatings Environment: Today's Opportunity, Tomorrow's Challenge," and programming will emphasize the international perspective, focusing on such areas as quality improvement, cutting edge technology, and environmentally and performance engineered products. Site is Metro Toronto Convention Centre.

Contact: Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422-2350 (215) 940-0777.

SOUTHERN

DALLAS-HOUSTON

Dallas/Houston-Area Locations

Southwestern Paint Convention—Mar. 13-15. Jointly sponsored by the Dallas and Houston Societies for Coatings Technology, this event focuses on current coatings topics and is held alternately at Dallas and Houston locations. The 1991 event will be held in Dallas.

Contact: Leo Michaelewicz, Proko Industries, 1860 LBJ Freeway, Suite 400, Mesquite, TX 75150 (214) 681-9261.

KANSAS CITY-ST. LOUIS

Kansas City/St. Louis-Area Locations

Annual Joint Meeting and Coatings Seminar—June 7-9. Program presentations are on coatings topics of current interest. The event, jointly sponsored by the Kansas City and St. Louis Societies for Coatings Technology, will be held at Holiday Inn, Lake of the Ozarks, MO.

Contact: Terry Gelhot, Carboline Co., 350 Hanley Industrial Court, St. Louis, MO 63144, (314) 644-1000 Ext. 2455.

SOUTHERN

Various Locations in Southeastern U.S.

Water-Borne, Higher Solids, and Powder Coatings Symposium—Feb. 6-8. Held annually each Winter under the joint sponsorship of the Southern Society for Coatings Technology and the University of Southern Mississippi. Program features over 30 papers addressing the chemistry and formulation of coatings. Site is Hyatt Regency Hotel, New Orleans, LA.

Contact: Dr. Shelby F. Thames, Dept. of Polymer Science, University of Southern Mississippi, Southern Station, Box 10076, Hattiesburg, MS 39406-0076 (601) 266-4868.

The Adhesion Society Annual Meeting—Feb. 17-20. This international event features papers by leading adhesion scientists and technologists. Site is Bellview Biltmore Hotel, Clearwater, FL.

Contact: Howard M. Clearfield, IBM, T.J. Watson Research Center, P.O. Box 218, M/S 38-145, Yorktown Heights, NY 10598.

Painting and Decorating Contractors National Convention and Exposition—Feb. 19-22. Held annually, the 1991 event will be at the Marriott Marquis, Atlanta, GA.

Contact: Painting and Decorating Contractors of America, 3913 Old Lee Highway, Suite 33-B, Fairfax, VA 22030 (703) 359-0826.

Annual Conference on Lead Paint Removal from Industrial Structures—Mar. 18-20. Sponsored by Steel Structures Painting Council, the 1991 event will be held at Omni Charlotte Hotel, Charlotte, NC.

Contact: Rose Mary Surgent, SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213-2683 (412) 268-3326.

Southern Society Annual Meeting—Apr. 3-6. The meeting program focuses on a variety of coatings topics. The 1991 event will be held at the Peabody Hotel, Memphis, TN.

Contact: Vernon Sauls, McCullough & Benton, P.O. Box 272360, Tampa, FL 33688 (813) 888-7273.

Spring Meeting of American Chemical Society—Apr. 14-19. One of two annual ACS national meetings (Fall Meeting will be in New York City, Aug. 25-30) featuring technical sessions and exhibits. Division of Polymeric Materials Science and Engineering sponsors presentations for each of these events on a variety of coatings related topics. The Spring meeting will be held in Atlanta, GA.

Contact: American Chemical Society, Dept. of Meetings & Divisional Activities, 1155 16th St., NW, Washington, DC 20036 (202) 872-4396.

Powder Coating Institute Annual Meeting—Apr. 29-May 1. Site is Sonesta Beach Hotel, Key Biscayne, FL.

Contact: Powder Coating Institute, 1800 Diagonal Rd., Suite 370, Alexandria, VA 22314 (703) 684-1770.

Marine and Offshore Coatings Conference—May 15-17. Sponsored by National Paint and Coatings Association, this annual event provides a forum for the marine industry and government agencies to discuss new developments in marine coatings. Site of 1991 event is Blockade Runner Hotel, Wrightsville Beach, NC.

Contact: NPCA, 1500 Rhode Island Ave., NW, Washington, DC 20005 (202) 462-6272.

National Association of Printing Ink Manufacturers Annual Technical Conference—Oct. 23-25. The 1991 event will be held at the Hotel Lago Mar, Ft. Lauderdale, FL.

Contact: NAPIM, 47 Halstead Ave., Harrison, NY 10528 (914) 835-5650.

WESTERN

GOLDEN GATE

San Francisco-Area Locations

Western Coatings Societies' Biennial Symposium and Show—Feb. 18-20. Jointly sponsored by the Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies for Coatings Technology, this event is held alternately at Los Angeles and San Francisco locations. The 1991 event, to be held at the San Francisco Hilton, San Francisco, CA, will have as its theme, "Coatings Science for the 90s," and will feature technical papers on a variety of coatings topics and the exhibits of supplier companies.

Contact: Patricia Stull, Pacific Coast Chemical Co., 2424 Fourth St., Berkeley, CA 94710 (415) 549-3535.

Manufacturing Seminar—June. Sponsored by the Golden Gate Society for Coatings Technology, this annual event presents discussions on the latest techniques for making coatings plant operations more efficient.

Contact: Louie Sanguinetti, Jasco Chemical Corp., P.O. Drawer 7, Mountain View, CA 94042 (415) 968-6005.

National Paint and Coatings Association Annual Meeting—Oct. 21-23. The 1991 event will be held at the San Francisco Hilton Hotel, San Francisco, CA.

Contact: NPCA, 1500 Rhode Island Ave., NW, Washington, DC 20005 (202) 462-6272.

LOS ANGELES

Southern California, Arizona, and Nevada Locations

Annual Conference of Architectural Spray Coaters Association—May 15-17. The 1991 event will be held at Loews Ventana Resort, Tucson, AZ.

Contact: ASCA, 230 W. Wells St., Ste. 311, Milwaukee, WI 53203.

PACIFIC NORTHWEST

Portland/Seattle/Vancouver-Area Locations

Annual Spring Symposium—May 2-4. Program devoted to coatings topics of current interest, under sponsorship of Pacific Northwest Society for Coatings Technology. Symposium site rotates among

the Portland, Seattle, and Vancouver Sections. The 1991 event, which will have as its theme, "Environment Friendly Coatings Options," will be held at the Hotel Meridien, Vancouver, B.C.

Contact: John P. Berghius, Kronos Canada, Inc., 3450 Wellington Ave., Vancouver, B.C. V5R 4Y4 (604) 438-7292.

INTERNATIONAL

Congress Exhibition for the Coatings, Printing Inks, Adhesives, and Sealants Industry—Mar. 19-21. Sponsored by farbe + lack magazine, event will be held at Exhibition Grounds, Nuremberg, Germany.

Contact: Klaus Geissler, Manager, Events Division, Curt R. Vincentz Verlag, Postfach 62 47, 3000 Hanover 1, Germany.

SITS '91 (International Exhibition on Surface Treatment and Industrial Finishing)—Apr. 15-19. Event will be held at Paris-Nord Villepinte, Paris, France.

Contact: SEPIC-SITS 91, 17 rue d'Uzes, F-75002, Paris, France.

Euro-Asian Interfinish Conference & Exhibition on Metal Finishing—Apr. 22-25. Site is Herzlia, Israel.

Contact: Euro-Asian Interfinish, P.O. Box 50432, Tel Aviv 61500, Israel.

Congress of Federation of Scandinavian Paint and Varnish Technologists (SLF)—May 12-15. The 1991 event will be held in Stockholm, Sweden.

Contact: Dr. Sven Gothe, c/o KABI, Franzengatan 9, 112 87 Stockholm, Sweden.

International Galvanizing Conference—June 2-7. Event will be held in Barcelona, Spain.

Contact: Zinc Development Association, 42 Weymouth St. London, England.

International Conference on Crosslinked Polymers—June 5-7. Site of Conference is Luzern, Switzerland.

Contact: Prof. Angelos V. Patsis, Director, Institute in Materials Science, CSB 209, State University of New York at New Paltz, New Paltz, NY 12561.

Surcon '91—June 12-14. Sponsored by Oil and Colour Chemists' Association (OCCA), event will be held at the Moat House International Hotel, Stratford-upon-Avon, England.

Contact: Chris Pacey-Day, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, England HAO 2SF.

SurCar '91 (International Conference on Automobile Body Finishing)—June 13-14. Site is Cannes, France.

Contact: Editiona Ampere, Dept. of Recontres Techniques, 25 rue Dagorno, 75012 Paris, France FAX: 33-1-43-47-30-80.

International Conference on Surface and Colloid Science (CSCS)—July 7-12. Sponsored by the International Association of Colloid and Interface Scientists, event will be held in Compiegne, France.

Contact: M. Clausse, Secretariat, ICSCS, c/o Wagons-Lits Tourisme, B.P. 244, 92307 Levallois-Perret Cedex, France.

International Conference on Organic Coatings Science and Technology—July 8-12. Sponsored by State University of New York (SUNY), event will be held in Athens, Greece.

Contact: Prof. Angelos V. Patsis, Institute in Materials Science, CSB 209, SUNY, New Paltz, NY 12561.

Annual Convention of Surface Coatings Association Australia (SCAA)—Aug. 8-10. Event features technical presentations and exhibits. Site is World Congress Centre, Melbourne, Australia.

Contact: Ian Blainey, Program Chairman, SCAA 1991 Convention, c/o I.C.I. Kenrez, P.O. Box 57, Cheltenham, Victoria 3192, Melbourne, Australia.

International Paint Congress—Sept. 3-5. Sponsored by The Brazilian Association of Paint Manufacturers (ABRAFAT), site of event is Anhembi Convention Centre, Sao Paulo, Brazil.

Contact: Especifica S/C Ltd., Rua Augusta, 2516-2nd Floor, Ste. 22, 01412, Sao Paulo, SP, Brazil.

The Polyurethanes World Congress 1991—Sept. 24-26. Co-sponsored by the European Isocyanate Producers Association and the Polyurethane Division of The Society of Plastics Industry (SPI), Inc. of the USA. Site is Acropolis Arts & Convention Centre, Nice, France.

Contact: Fran Lichtenberg, Polyurethane Div., SPI, 355 Lexington Ave., New York, NY 10017.

Radtech Europe '91—Sept. 29-Oct. 2. Conference and exhibition, to be held at the Edinburgh Exhibition and Trade Centre, Edinburgh, Scotland.

Contact: Conference Secretary, Radtech '91, c/o PRA, Waldegrave Rd., Teddington, Middlesex TW11 8LD, England.

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DOW CORNING

Solvent and Catalyst Effects In the Reaction of Dicyclohexylmethane Diisocyanate with Alcohols and Water

Stephen D. Seneker and Terry A. Potter
Mobay Corporation*

The following catalysts, dimethyl- and dibutyl-tin dichloride, and dimethyl- and dibutyl-tin dilaurate, are compared to determine the effect of the alkyl group and labile ligand on the reaction kinetics of 4,4′-dicyclohexylmethane diisocyanate (reduced MDI, rMDI) with 1000 MW polytetramethylene glycol (PTMG-1000). The less sterically hindered dimethyl-tin catalysts were more active on a mole for mole basis than the dibutyl-tin counterparts. We also found that the dialkyltin dichloride catalysts have significantly lower activation energies than the dilaurate catalysts.

The kinetic results from the rMDI/PTMG-1000 reaction are compared with the model reaction of rMDI with n-butanol using two different solvents: N-methyl-2-pyrrolidone (NMP) and triethylene glycol dimethyl ether (triglyme). Triglyme, being a polyether, was a good model solvent for simulating the reaction kinetics of rMDI with polytetramethylene glycol.

We also determined the effect of catalyst structure on the reaction kinetics of rMDI with water and found that there was no significant alkyl group or labile ligand effect.

From this information, the apparent selectivity of rMDI towards n-butanol and water was determined by a simple ratio of the reaction rates. In general, the dimethyl-tin catalysts resulted in a higher selectivity towards n-butanol than the dibutyl-tin catalysts. The temperature had no effect on the apparent selectivity with the tin dichloride catalysts; however, the selectivity increased with increasing temperature with the dilaurate catalysts. This information may be useful in formulating coatings that are less sensitive to side reactions with water, yet have a reasonable cure rate.

INTRODUCTION

Two-component high solids coatings formulated from polyisocyanates have been used in industry for many years with great success. Polyurethane films give a combination of hardness and flexibility that is unsurpassed by other systems. Aliphatic polyisocyanate systems are particularly suitable for top coats due to their excellent light stability and weatherability. One potential drawback of aliphatic isocyanates is their lower reactivity in comparison to aromatic isocyanates; however, this can be overcome through use of a catalyst.

Previous work on the catalysis of aliphatic isocyanates with alcohols has identified a wide variety of metal compounds which contain labile ligands as effective catalysts.[1-4] Tertiary amines are well known catalysts for aromatic isocyanates but are relatively ineffective with aliphatic isocyanates.[1-3] In a recent study by Squiller and Rosthauser,[5] a series of tin catalysts were found to be effective in accelerating the reaction of 4,4′-dicyclohexylmethane diisocyanate (rMDI) with n-butanol. The reaction kinetics were determined under pseudo first-order conditions using a large excess of n-butanol (NCO:OH = 1:15). The present study was conducted under more practical conditions (NCO:OH = 2:1).

In this paper, we compare the reaction kinetics of rMDI with alcohols and water using dimethyl- and dibutyl-tin

Presented at the 16th Water-Borne and Higher-Solids Coatings Symposium, in New Orleans, LA, February 2, 1989.
*New Martinsville, WV 26155-0500.

		MW
DMTDL	$(CH_3)_2Sn(O-\overset{O}{\overset{\|}{C}}-(CH_2)_{10}CH_3)_2$	547.4
DBTDL	$(CH_3CH_2CH_2CH_2)_2Sn(O-\overset{O}{\overset{\|}{C}}-(CH_2)_{10}CH_3)_2$	631.6
DMTDC	$(CH_3)_2SnCl_2$	219.7
DBTDC	$(CH_3CH_2CH_2CH_2)_2SnCl_2$	303.8

Figure 1—Structures of the catalysts: dimethyltin dilaurate (DMTDL), dibutyltin dilaurate (DBTDL), dimethyltin dichloride (DMTDC), and dibutyltin dichloride (DBTDC)

dichloride, and dimethyl- and dibutyl-tin dilaurate as catalysts (*Figure* 1). These catalysts were chosen to determine the alkyl group effect (dimethyl vs dibutyl) and the labile ligand effect (dichloride vs dilaurate) on the reaction kinetics. The evaluation consisted of measuring reaction rates at 40 and 60°C and then calculating the activation energy in that temperature range.

We first evaluated the catalysts in a practical system consisting of rMDI and 1000 MW polytetramethylene glycol (PTMG-1000) at an NCO to OH ratio of 2.00 to form an isocyanate-terminated polyether. The results of this reaction were then compared with the model reaction of rMDI with n-butanol using two different solvents: N-methyl-2-pyrrolidone (NMP) and triethylene glycol dimethyl ether (triglyme). The effects of solvent type and catalyst structure on the reaction kinetics are discussed.

We also determined the effect of catalyst structure on the reaction rate of rMDI with water. Using these results, we determined the effect of catalyst and temperature on the selectivity of rMDI towards n-butanol vs water by looking at the ratio of the reaction rates. The importance of this information in formulating coatings that are less sensitive to side reactions with water is discussed.

EXPERIMENTAL

Materials

The 4,4′-dicyclohexylmethane diisocyanate (rMDI; Desmodur W, Mobay Corporation) had a hydrolyzable chloride content of less than 2 ppm, and was used without further purification. The 4,4′-isomer distribution consisted of 22.7% of the trans,trans isomer, 62.2% of the cis,trans isomer, and 15.1% of the cis,cis isomer as measured by gas chromatography.

Table 1—Kinetic Data for Reaction of r-MDI with PTMEG-1000

Catalyst[a]	Rate Constant (kg/mole min) 40°C	Rate Constant (kg/mole min) 60°C	Activation Energy (Ea) (kcal/mole)
DMTDL	2.6×10^{-3}	1.7×10^{-2}	18.6
DBTDL	1.2×10^{-3}	7.6×10^{-3}	18.7
DMTDC	2.6×10^{-3}	1.1×10^{-2}	14.0
DBTDC	1.2×10^{-3}	4.7×10^{-3}	13.5

(a) Catalyst concentration is in molality: [DMTDL] = 3.7×10^{-5}; [DBTDL] = 3.2×10^{-5}; [DMTDC] = 4.6×10^{-5}; and [DBTDC] = 3.3×10^{-5}.

The polytetramethylene glycol (OH # 109.9; MW 1021; PTMG-1000; Terathane 1000, DuPont) was dried under vacuum to a water content of less than 0.01 wt %.

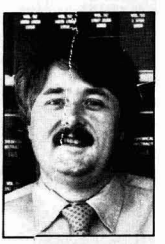
The N-methyl-2-pyrrolidone (Aldrich Chemical Company), triethylene glycol dimethyl ether (Aldrich Chemical Company), and n-butanol (Gold Label-Aldrich Chemical Company) contained less than 0.01 wt % water and were used without further purification.

Dimethyltin dichloride (DMTDC; Fluka) was recrystallized from hexane before use. Dibutyltin dichloride (DBTDC; Fluka), dimethyltin dilaurate (DMTDL; UL-28, Witco Corporation), and dibutyltin dilaurate (DBTDL; T-12, M & T Chemicals, Inc.) were all used without further purification.

Reaction Kinetics

Refractive Index Method: The procedure for determining the reaction rates of rMDI with PTMG-1000 is outlined in the following. We charged the PTMG-1000 into a 250-mL three-neck flask equipped with a thermometer, mechanical stirrer, and condenser fitted with a drying tube. The solution was heated to and maintained at either 40 or 60°C (±0.2°C). The rMDI, preheated to the same temperature as the PTMG-1000, was added to the flask and followed immediately by the appropriate amount of catalyst solution (1.00 wt % in rMDI). We used an isocyanate to hydroxyl ratio of 2.00. After the addition of these components, a sample was withdrawn and the time marked as t = 0. Additional samples were withdrawn at specified times and the refractive index measured ($n_{25°}$ — uncorrected). In initial experiments, a second sample was withdrawn at the same time to establish the correlation between $n_{25°C}$ and % NCO (degree of reaction). The percent isocyanate was determined by adding excess dibutyl amine solution to the weighed sample

STEPHEN D. SENEKER received the B.A. Degree in Chemistry from Point Loma Nazarene College. He received the Ph.D. Degree in Chemistry with an emphasis in Polymers and Coatings from North Dakota State University. Upon graduation in 1986, Dr. Seneker joined Mobay Corporation with the Coatings Group of the Polyurethane Research Department. Dr. Seneker presently is a Senior Chemist in the Specialty Polyurethane Group at New Martinsville, WV.



TERRY A. POTTER received the B.A. Degree from Coe College and the Ph.D. Degree from the University of Iowa. He joined Mobay Corporation in 1979 and since 1980 has worked on a variety of assignments within the Coatings Group of the Polyurethane Research Department. From 1981-1983, Dr. Potter was assigned to Bayer A.G. working in the Polyurethane Coatings Research Group in Leverkusen, West Germany. He currently is a Section Manager in the Coatings Group at the New Martinsville, WV location.

and then back titrating with standard hydrochloric acid solution.[6] The equation used to convert the refractive indices to % NCO as determined by a least squares fit program is given below (correlation coefficient = 0.9995).

$$\% \text{ NCO} = \frac{1.4926 - [n_{25°C}]}{0.00189}$$

TITRATION METHOD: The procedure for determining the reaction rates of rMDI with n-butanol and water is given as follows. The solvent (100 gm), 0.30 equivalents rMDI, and 0.15 equivalents coreactant (n-butanol or water) were charged into a 250-mL three-neck flask equipped with a thermometer, mechanical stirrer, and condenser fitted with a drying tube. The solution mixture was heated to either 40 or 60°C over a 15-minute time period. Immediately after reaching the desired temperature, the catalyst was charged as a 1.00 wt % solution in rMDI. Control experiments indicated that no significant reaction took place during the 15 minute heat up period. After thoroughly mixing, a sample was withdrawn and the time was marked as t = 0. The % NCO was determined by adding excess dibutyl amine solution to the weighed sample and back titrating with standard hydrochloric acid solution.[6]

Data Analysis

Plots of 1/[NCO] vs time were linear, indicating second-order reaction kinetics as shown in *Figure* 2 for the reaction of rMDI with n-butanol at 60°C using triglyme as a solvent. The apparent rate constant, k, corresponded to the slope of the best-fit line of up to 40% reaction conversion. A plot of the percent reaction conversion vs time is given in *Figure* 3.

RESULTS AND DISCUSSIONS

Reaction of rMDI with Polytetramethylene Glycol

The reaction of rMDI with 1000 MW PTMG-1000 at an NCO:OH of 2:1 to form an isocyanate-terminated polyether is illustrated in *Figure* 4. The apparent rate constants at 40 and 60°C, and the activation energies in that temperature range are given in *Table* 1. The activation energy is given by the slope of the line when the ln(rate) is plotted vs 1/temperature (Arrhenius Plot), as illustrated in *Figure* 5.

Analysis of the data at a 95% confidence limit indicated that the nature of the labile ligand (dilaurate vs dichloride) has a significant effect on the activation energy (DMTDL-18.8 vs DMTDC-14.0, and DBTDL-19.6 vs DBTDC-13.6). The alkyl group had no significant effect on the activation energy.

Reaction of rMDI with n-Butanol

The results of the rMDI/PTMG-1000 reaction were then compared to the model reaction of rMDI with n-butanol using NMP as a solvent. This solvent was chosen because it can solubilize n-butanol or water with rMDI. Also, NMP is a common solvent for isocyanate-terminated prepolymers intended for aqueous polyurethane dispersions.

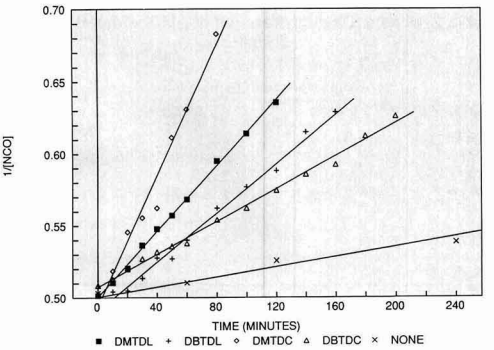


Figure 2—Plot of 1/NCO vs time for the reaction of rMDI with n-butanol at 60°C using triglyme as a solvent. Legend: DMTDL—■; DBTDL—+; DMTDC—◇; DBTDC—△; and None—X

The kinetic results of rMDI reacted with n-butanol are given in *Table* 2. These results were surprising because the dichloride catalysts had higher activation energies than the dilaurate catalysts, which is the reverse of that observed for the rMDI/PTMG-1000 reaction. The alkyl group did not affect the activation energy but it did affect the apparent reaction rate. The dimethyltin catalysts were more active than the dibutyltin catalysts.

Based on these results, we decided to change solvents from NMP to triethylene glycol dimethyl ether (triglyme). Triglyme is a polyether and should therefore provide a reaction matrix more similar to PTMG-1000. Water and rMDI are both miscible in triglyme, as well, which is important to another part of this study.

The kinetic results of the rMDI/n-butanol reaction using triglyme as a solvent are in *Table* 3. In general, the reaction rates were greater in triglyme than in NMP. Interestingly, the activation energies are very similar to

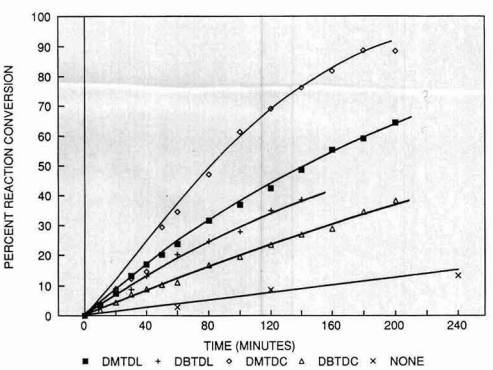


Figure 3—Plot of percent reaction conversion vs time for the reaction of rMDI with n-butanol at 60°C using triglyme as a solvent. Legend: DMTDL—■; DBTDL—+; DMTDC—◇; DBTDC—△; and None—X

Table 2—Kinetic Data for Reaction of r-MDI with n-Butanol in NMP[a]

Catalyst[b]	Rate Constant (kg/mole min) 40°C	60°C	Activation Energy (Ea) (kcal/mole)
DMTDL	10.0×10^{-4}	4.0×10^{-3}	13.7
DBTDL	4.1×10^{-4}	1.6×10^{-3}	13.6
DMTDC	1.4×10^{-3}	7.0×10^{-3}	15.8
DBTDC	4.2×10^{-4}	1.9×10^{-3}	15.0

(a) Uncatalyzed reaction rate @ 60°C = 8.9×10^{-5}.
(b) [Catalyst] = 1.05×10^{-5} molality.

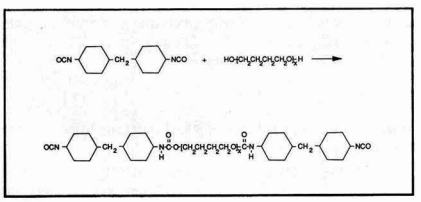


Figure 4—Reaction of rMDI with polytetramethylene glycol

Table 3—Kinetic Data for Reaction of r-MDI with n-Butanol in Triglyme[a]

Catalyst[b]	Rate Constant (kg/mole min) 40°C	60°C	Activation Energy (Ea) (kcal/mole)
DMTDL	1.2×10^{-3}	7.3×10^{-3}	18.3
DBTDL	8.4×10^{-4}	5.2×10^{-3}	18.2
DMTDC	2.3×10^{-3}	8.8×10^{-3}	13.1
DBTDC	5.5×10^{-4}	2.2×10^{-3}	13.5

(a) Uncatalyzed reaction rate @ 60°C = 1.4×10^{-4}.
(b) [Catalyst] = 1.05×10^{-5} molality.

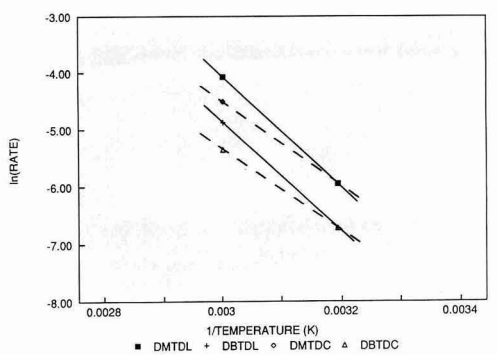


Figure 5—Plot of ln(rate) vs 1/temperature for the reaction of rMDI with polytetramethylene glycol

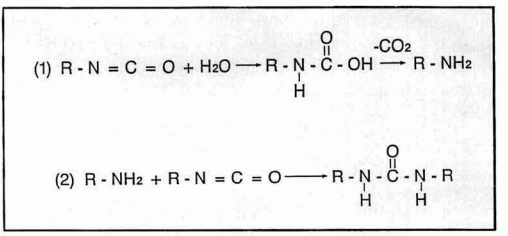


Figure 6—Reaction of an isocyanate with water

the rMDI/PTMG-1000 reaction. Triglyme appears to be a good model solvent for simulating the reaction kinetics of rMDI with polytetramethylene glycol. These results indicate that the reaction matrix has a tremendous effect on the reaction kinetics.

Reaction of rMDI with Water

One aspect of aliphatic isocyanate chemistry that has not received much attention is the effect of catalyst on the reaction of an isocyanate with water. The reaction is illustrated in *Figure* 6. For this reason, we evaluated the effect of the tin catalysts on the rMDI/water reaction.

Kinetic data for the reaction of rMDI with water using NMP and triglyme as solvents are summarized in *Table* 4. The rate constants include both the reaction of isocyanate with water to form an amine and the reaction of the amine with an isocyanate to form an urea. Interestingly, there was no significant alkyl group or labile ligand effect on the activation energy. Also, the solvent effect was minimal in comparison to the reactions with n-butanol.

Effect of Catalyst Structure On the Apparent Selectivity of rMDI

A "selective" catalyst that could accelerate the reaction rate of isocyanates with hydroxyls without accelerating the reaction rate with water would help alleviate many problems. For example, in the synthesis of isocyanate-terminated prepolymers, reaction with water impurity will cause unwanted high viscosities and possible turbidity or precipitation due to polyurea formation. Accelerated isocyanate reaction at the surface during film curing of a one-component or two-component formulation can cause bubble formation in the film (carbon dioxide entrapment). However, there are some cases where a "*non*-selective" catalyst might be advantageous, such as in a moisture-cure formulation. For these reasons, we studied the effect of catalyst on the selectivity of rMDI.

The apparent selectivity is defined by the ratio of the rate constants of rMDI with n-butanol to that of water. The selectivities are given in *Table* 5. In general, the dimethyltin catalysts promoted slightly higher selectivities than the dibutyltin catalysts. The solvent and temperature affected the apparent selectivity of rMDI when using dialkyltin dilaurate catalysts. In NMP, the selectivity decreased slightly with increasing temperature. However, with triglyme as solvent, the selectivity increased with temperature. With the dialkyltin dichloride catalysts, there was no significant solvent or temperature effect.

Table 4—Kinetic Data for Reaction of r-MDI with Water in NMP and Triglyme[a]

Catalyst[b]	Solvent	Rate Constant (kg/mole min) 40°C	Rate Constant (kg/mole min) 60°C	Activation Energy (Ea) (kcal/mole)
DMTDL	NMP	4.1×10^{-4}	1.9×10^{-3}	15.0
	Triglyme	3.6×10^{-4}	1.4×10^{-3}	13.5
DBTDL	NMP	3.4×10^{-4}	1.6×10^{-3}	15.5
	Triglyme	4.8×10^{-4}	1.6×10^{-3}	12.3
DMTDC	NMP	3.9×10^{-4}	1.8×10^{-3}	15.4
	Triglyme	6.1×10^{-4}	2.4×10^{-3}	13.4
DBTDC	NMP	2.6×10^{-4}	1.1×10^{-3}	14.7
	Triglyme	4.6×10^{-4}	1.6×10^{-3}	12.5

(a) Uncatalyzed reaction rate @ 60°C: 3.36×10^{-4} (NMP); 1.3×10^{-5} (triglyme).
(b) [Catalyst] = 1.13×10^{-5} molality.

Table 5—Apparent Selectivity[a] of Catalysts in NMP and Triglyme

Catalyst	Solvent	Selectivity 40°C	Selectivity 60°C
DMTDL	NMP	2.4	2.1
DMTDL	Triglyme	3.2	5.3
DBTDL	NMP	2.2	1.2
DBTDL	Triglyme	1.8	3.2
DMTDC	NMP	3.7	3.8
DMTDC	Triglyme	3.8	3.7
DBTDC	NMP	0.9	1.2
DBTDC	Triglyme	1.2	1.3

(a) Ratio of n-butanol to water rate constants.

All apparent selectivity effects are actually a restatement of the effect of temperature on the individual reaction rates of n-butanol and water (i.e., activation energy). For example, the activation energy of the rMDI/n-butanol reaction using dimethyltin dilaurate as catalyst and triglyme as solvent was 18 kcal/mole, and for water it was 13 kcal/mole. So the apparent selectivity will be expected to increase in going from 40 to 60°C.

CONCLUSIONS

Tin catalysts are commonly utilized in two-component high solids polyurethane coatings. However, not all tin catalysts behave alike. This study has shown that, by proper choice of the catalyst structure, one can affect the overall reactivity of an isocyanate with hydroxyl containing compounds, and the selectivity of an isocyanate towards hydroxyls versus water. Also, the nature of the reaction matrix has a large effect on the reaction kinetics.

ACKNOWLEDGMENTS

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References

(1) Britain, J. W. and Gemeinhardt, P. G., *J. Appl. Polymer Sci., 4,* 207 (1960).
(2) Oberth, A.E. and Bruenner, R.S., *I&EC Fundamentals, 8,* 383 (1969).
(3) Anzuino, G., Pirro, A., Rossi, G., and Polo Friz, L., *J. Polymer Sci., 13,* 1667 (1975).
(4) Yilgor, I. and McGrath, J.E., *J. Appl. Polymer Sci., 30,* 1733 (1985).
(5) Squiller, E.P. and Rosthauser, J.W., "Catalysis in Aliphatic Isocyanate-Alcohol Reactions," *Modern Paint and Coatings,* June 1987.
(6) David, D.J. and Staley, H.B., *Analytical Chemistry of Polyurethanes, High Polymer Series,* XVI, Part III, Wiley Interscience, New York, 1969.

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Determination of the Protective Properties Of Cationic Primers with A.C. Impedance Measurements

V.B. Mišković-Stanković and D.M. Dražić
University of Belgrade*

N.M. Aćamović
Zastava Laboratory†

A.C. impedance measurements were carried out on organic coatings of different thicknesses electrodeposited on different substrates: steel, phosphatized steel, and phosphatized zinc electroplated steel. The values of the pore resistance, capacitance, and relative permittivity of protective primers show the effects of the type of substrate and film thickness on corrosive behavior. The coatings formed on steel and phosphatized steel have greater values of pore resistance and smaller values of capacitance and relative permittivity than coatings formed on phosphatized zinc electroplated steel. An increase in the film thickness increases the pore resistance and decreases the capacitance which points to better protective properties and greater stability. At initial times while the coatings keep their protective properties against the corrosive agent (3% NaCl), relative permittivity was independent of film thickness. As time progresses, however, the increase in film thickness decreases the relative permittivity of the coating, indicating the deterioration of the protective film.

INTRODUCTION

The mechanism by which a polymer coating protects a metal substrate against corrosion is of great interest. A number of electrochemical methods are available to test the protective properties of coatings in corrosive environments,[1] and those based on impedance measurements are frequently used. As a result of the study of polymer-coated steel, phosphatized steel, aluminum alloys, and conversion coated aluminum alloys, a general equivalent circuit model for the behavior of polymer-coated metals has been developed (*Figure* 1),[2–4] where R_Ω is the resistance of the electrolyte and surface film, R_p is the pore resistance due to electrolyte penetration, R_t is the metals charge-transfer resistance, C_c is the capacitance of the film, and C_d is the electrical double layer capacitance at the metal/solution interface.

In this paper, some results of investigations concerning the characteristics of organic films electrodeposited on steel, phosphatized steel, and phosphatized zinc electroplated steel are discussed.

EXPERIMENTAL

The so-called conventional cationic primers (thickness 17 μm) were deposited in a bath made of a two-component cataphoretic material (paste and emulsion, ED 3002, produced by Industrie Vernici Italiane under PPG license) with a binding material based on epoxy resin modified by an isocyanate component. High build coatings (thickness 33 μm) were deposited in a bath made of a two-component material (UNI-PRIME ED 3060 produced by I.V.I. under PPG license) with a binding material based on

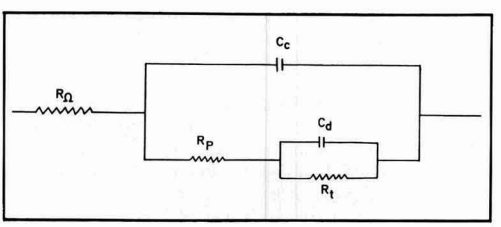

Figure 1—Impedance model of a polymer coated metal

*Faculty of Technology and Metallurgy, P.O. Box 494, 11001 Belgrade, Yugoslavia.
†34000 Kragujevac, Yugoslavia.

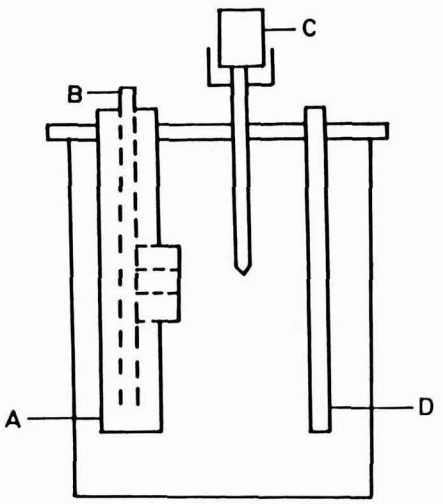

Figure 2—Electrochemical cell: A—Teflon holder; B—working electrode, coated steel coupon; C—reference electrode, saturated calomel electrode; D—counter electrode, platinum mesh with a surface area considerably greater than that of the working electrode

epoxy resin modified by an isocyanate and diol component. The bath properties were as follows: binder content, 15 wt %; pigment content, 5.5 wt %; pH = 6.20; conductivity at 20°C, 1050 $\mu S\ cm^{-1}$; and temperature, 26°C ± 1 for conventional coatings and 28°C ± 1 for high build coatings. The constant deposition voltage was 300 V from a 3 dm^3 bath volume. Deposition was done on both sides of the samples (coupons 20 × 20 × 1 mm), on different substrates: steel (Č0147, German equivalent DIN-RR St 14), phosphatized steel, and phosphatized zinc electroplated steel. The bath was moderately stirred mechanically. After coating for 2 min for conventional primers and 3 min for high build primers, rinsing and baking at 180°C for 30 min, the film thickness was measured using a PERMASCOPE thickness tester. The coated samples were exposed to 3% NaCl in distilled water for a period of 10 days. A three-electrode cell arrangement was used in the experiments (*Figure* 2). The working electrode was a coated steel panel (20 × 20 × 1 mm) situated in a special Teflon holder so that the exposed surface of the tested specimen in its center was 1 cm^2. The counter electrode was platinum mesh with a surface area considerably greater than that of the working electrode (50 cm^2). The reference electrode was a saturated calomel electrode. The volume of the test solution inside the cell was 150 cm^3.

A.C. impedance data were obtained at the open-circuit potential using a PAR 273 potentiostat and PAR 5301 lock-in amplifier. The data were stored and analyzed using an IBM PS-30 computer and an EPSON FX-1000 plotter. The impedance measurements in all cases were carried out over a frequency range of 100 kHz to 10 mHz using a 5 mV peak-to-peak sinusoidal voltage. The experimental results were analyzed by means of a computerized semicircle fitting routine.

RESULTS AND DISCUSSION

Influence of the Film Thickness

Figure 3 presents the Nyquist complex plane plots for the impedance of a conventional coating (thickness 17 μm) and a high build coating (thickness 33 μm) electrodeposited on phosphatized steel. In the complex plane diagram, the resistance of the electrolyte and surface film, R_Ω, can be calculated from the high frequency intercept of the semicircle with the real axis and pore resistance, R_p, can be calculated from the low frequency intercept.[5] The capacitance, C_c, which has been interpreted as the capacitance of areas where rapid solution uptake does not occur,[6] can be determined from the frequency, $f_{max(h)}$, at which the reactive component of impedance, $-Z''$, reaches a maximum value at high frequency semicircle and pore resistance, R_p:

$$C_c \approx 1/2\pi f_{max(h)} R_p \qquad (1)$$

The electrical double layer capacitance, C_d, can be determined from the frequency, $f_{max(1)}$, at which $-Z''$ reaches a maximum value at low frequency semicircle and R_t:

$$C_d \approx 1/2\pi F_{max(1)} R_t \qquad (2)$$

The relative permittivity of protective coating, ϵ_r, can be calculated from film thickness and film capacitance using equation:

$$\epsilon_r = \frac{C_c \delta}{\epsilon_o} \qquad (3)$$

where δ is film thickness and $\epsilon_o = 8.85 \times 10^{-12}$ F/m, permittivity of the vacuum. Results show (*Table* 1) that a high build coating has greater values of R_Ω and R_p and a smaller value of C_c than conventional coating which points to better protective properties. The pore resistance, which represents the extent of ionic conduction through the polymer in electrolytic environments, decreases over time, indicating an increasing ionic conductivity for the coating layer and a lower protective capacity due to electrolyte penetration.[7,8] The pore resistance values indicate the quality of the layer adhesion to the substrate,[9] which is one of the most important features for the quality of a coating, its porosity and microdefects, water uptake, and degradation of the coating.[10] So, greater pore resistance values point to better protective properties of coatings. The pore resistance, as a resistance of the ionic paths, correlates also with the development of corrosion.[8] It has

Table 1—Resistance of Electrolyte and Surface Film, Pore Resistance, Charge-Transfer Resistance, Capacitance of the Film, and Electrical Double Layer Capacitance, for Conventional and High Build Coatings after 10 Days' Exposure to 3% NaCl

Primer	Thickness/μm	R_Ω/Ω	R_p/Ω	$C_c x10^{10}/F$	R_t/Ω	$C_d x10^8/F$
Conventional	17	311	6386	3.13	7337	5.44
High build	33	5511	38878	1.63	—	—

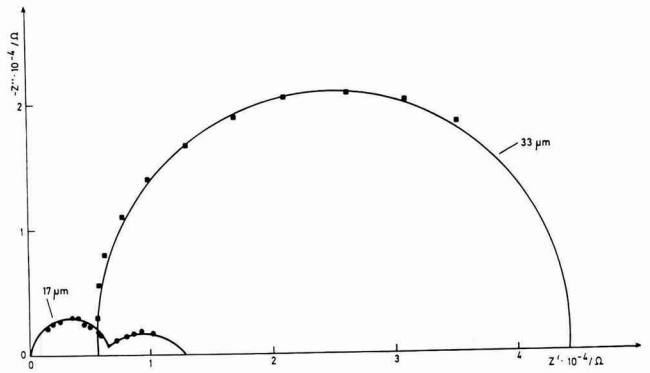

Figure 3—Complex plane plots for conventional coating (17 μm) and high build coating (33 μm) electrodeposited on phosphatized steel after 10 days' exposure to 3% NaCl

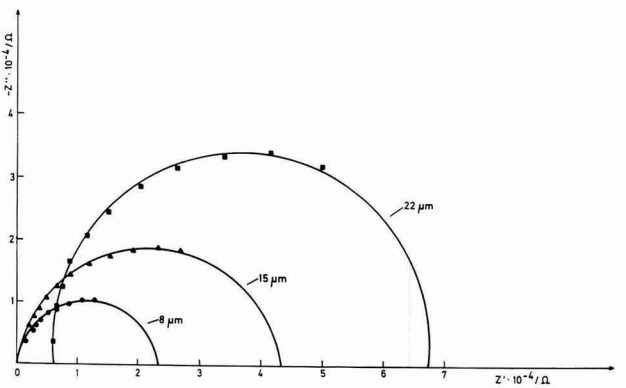

Figure 4—Complex plane plots for coatings of different thicknesses, electrodeposited on steel after 10 days' exposure to 3% NaCl

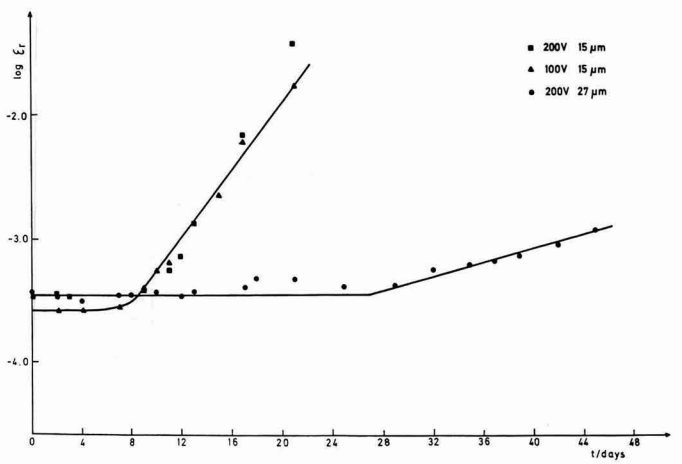

Figure 5—Relative permittivities for films of different thicknesses as a function of exposure time

Table 2—Pore Resistance and Capacitance for Coatings of Different Thicknesses after 10 Days' Exposure to 3% NaCl

Thickness/μm	R_p/Ω	$C_c x 10^{10}/F$
8	23452	3.39
15	43135	2.92
22	61718	1.62

been experimentally proven that a decrease in pore resistance is related to the increase of the corrosion rate[2,3,11-13] which suggests that the pore resistance can be considered as the criterion for estimating the protective properties of organic films against corrosion.

For the measurement when immersion time was 10 days, in the case of the conventional coating, a new semicircle appeared in the impedance plot at low frequencies (*Figure* 3), which enabled the determination of R_t and C_d. These values provide information about the extent of the corroding area under the coating[11] as a consequence of the progressive degradation of the coating itself. In the case of a high build coating, a new semicircle does not appear for the same immersion time, which points to greater stability.

Figure 4 presents the Nyquist complex plane plots for the impedance of coatings of different thicknesses which are electrodeposited on steel. The results obtained from those plots show (*Table* 2) that an increase in the film thickness increases the pore resistance and decreases the capacitance. The effect of film thickness on the relative permittivity of coatings is shown in *Figure* 5. Relative permittivity would seem a *priori* to depend entirely on the nature of the polymer coating and would have no significant relationship to the applied voltage. In fact, at initial times before significant exposure to the electrolyte, ϵ_r shows a little variation with applied voltage and film thickness. However, as time progresses, the ϵ_r values of coatings of different thicknesses increase at different rates. Changes of relative permittivity over time are almost the same for coatings of the same thicknesses formed at different voltages (100 V and 200 V). However, a coating two times thicker formed at the same voltage (200 V) shows considerably greater stability in the corrosive medium as evidenced by the maintenance of initial values of relative permittivity for longer time. This means that the film thickness alone determines the corrosion behavior,[14,15] and because of that, an increase in the film thickness increases the pore resistance and decreases the capacitance of the coating (*Table* 2).

Influence of the Substrate

Nyquist complex plane plots for the impedance of coatings of the same thicknesses (33 μm) formed on different substrates are shown in *Figure* 6. As seen, the type of substrate also influences the coating's anti-corrosion behavior. Pore resistance was determined from the low frequency intercept of the semicircle with the real axis, and the capacitance and relative permittivity were calculated using equations (1) and (3). Results show (*Table* 3) that a coating electrodeposited on phosphatized zinc electroplated steel has smaller pore resistance and greater capacitance and relative permittivity than coatings electrodeposited on phosphatized steel and steel, respectively.

The pore resistance, R_p, decreases as the test proceeds, denoting an increasing ionic conductivity in the coating layer and a lesser protective capacity due to electrolyte penetration. Physically, it represents a heterogeneous assembly of electrolytically conducting paths.[7,8] There are two types of behavior. In some localized areas, the coating does not behave as a dielectric, but exhibits electrolytic conductivity as a consequence of polymer breakdown, either because the electrolyte is dissolved within a hydrolyzed region, or because of penetration by the electrolyte through the pores. In other localized areas, the coating remains a highly crosslinked, relatively inert, dielectric material. The entire system, coating/metal oxide/metal substrate, may be considered to consist of electrolytically activated, conducting regions penetrating the coating randomly over the surface with respect to depth. According to this model, penetration of the coating by the electrolyte results in an impedance behavior which is typical of a dielectric film short-circuited by conducting electrolytic paths perpendicular and parallel to the polymer/metal interface. The fact that the coating formed on phosphatized zinc electroplated steel has a

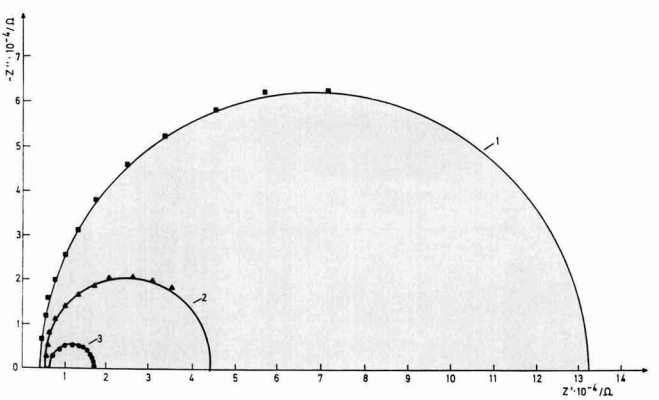

Figure 6—Complex plane plots for coatings formed on different substrates: 1—steel sheet; 2—phosphatized steel sheet; 3—phosphatized zinc electroplated steel sheet, after 10 days' exposure to 3% NaCl

Table 3—Pore Resistance, Capacitance, and Relative Permittivity for Coatings Formed on Different Substrates after 10 Days' Exposure to 3% NaCl

Substrate	R_p/Ω	$C_c x 10^{10}/F$	$\epsilon_r x 10^4$
Steel	128398	1.56	5.82
Phosphatized steel	38878	1.63	6.08
Phosphatized zinc electroplated steel	10770	2.34	8.72

smaller R_p than coatings formed on phosphatized steel and steel, respectively, can be explained by the zinc dissolution which causes an increase in Zn^{2+} ion concentration inside the pores with a local decrease in pore resistance.[16,17] The place of coating failure, due to penetration by the electrolyte, becomes the anode, where Zn dissolves as Zn^{2+}, and the Zn layer under the coating becomes the cathode, where OH^- ions are formed by the reduction of oxygen. Thus, a local cell is formed. Cations such as Na^+ ions migrate through the film to the cathode, and, as a result, OH^- ions accumulate there. The alkali attacks the coating, phosphate, and Zn. Because of that, the coating electrodeposited on phosphatized zinc electroplated steel has smaller pore resistance, R_p, and greater capacitance, C_c, and relative permittivity, ϵ_r, than coatings formed on phosphatized steel and steel, respectively.

CONCLUSION

Film thickness and substrate type affect organic coating properties during exposure to a corrosive agent. High build coatings have greater pore resistance and smaller capacitance than conventional coatings. An increase in the film thickness increases the pore resistance and decreases the capacitance which points to better protective properties and greater stability. This behavior can be explained by the fact that the film thickness determines the anti-corrosion properties. The fact that the coatings formed on phosphatized zinc electroplated steel have smaller pore resistance and greater capacitance and relative permittivity than coatings formed on phosphatized steel and steel, respectively, can be explained by the zinc dissolution which causes an increase in Zn^{2+} ion concentration inside the pores with a local decrease in pore resistance.

ACKNOWLEDGMENT

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References

(1) Leidheiser, H. Jr., *Prog. Org. Coat., 7*, 79 (1979).
(2) Beaunier, L., Epelboin, I., Lestrade, J.C., and Takenouti, H., *Surf. Technol., 4*, 237 (1976).
(3) Scantlebury, J.D. and Ho, K.N., *J. Oil & Colour Chemists' Assoc., 62*, 89 (1979).
(4) Mansfeld, F., Kendig, M.W., and Tsai, S., *Corrosion, 38*, 478 (1982).
(5) Walter, G.W., *Corrosion Sci., 26*, 681 (1986).
(6) Walter, G.W., *J. Electroanal. Chem., 118*, 259 (1981).
(7) Kendig, M.W. and Leidheiser, H. Jr., *J. Electrochem. Soc., 123*, 982 (1976).
(8) Kendig, M.W., Mansfeld, F., and Tsai, S., *Corrosion Sci., 23*, 317 (1983).
(9) Gerasimenko, S. and Sorokin, I., *Zaschita Metallov, 15*, 631 (1979).
(10) Cerisola, G. and Bonora, P.L., *Materials Chemistry, 7*, 241 (1982).
(11) Callow, L.M. and Scantlebury, J.D., *J. Oil & Colour Chemists' Assoc., 64*, 119 (1981).
(12) Hubrecht, J., Vereecken, J., and Piens, M., *J. Electrochem. Soc., 131*, 2010 (1984).
(13) Lunazzi, G.C. and Maja, M., *Pitture e Vernici, 60*, 55 (1984).
(14) Dražić, D.M. and Mišković-Stanković, V.B., *Corrosion Sci., 30*, 575 (1990).
(15) Dražić, D.M. and Mišković-Stanković, V.B., *Prog. Org. Coat., 18*, 251 (1990).
(16) Miyoshi, Y., Kitayama, M., Nishimura, K., and Naito, S., *SAE Paper* 850007, Detroit, February 25-March 1 (1985).
(17) Dražić, D.M., Aćamović, N.M., and Stojanović, O.D., "Heating of the Cathode During the Electrodeposition of Cationic Primers," JOURNAL OF COATINGS TECHNOLOGY, *61*, No. 771, 27 (1989).

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Zinc Reactivity in Zinc-Rich Coatings Co-Pigmented with Di-Iron Phosphide

S. Feliu, Jr., M. Morcillo, J.M. Bastidas, and S. Feliu
Centro Nacional de Investigaciones Metalurgicas*

The attack of zinc particles in zinc-rich coatings is relatively insensitive to the quantity of di-iron phosphide and the type of vehicle (ethyl silicate or epoxy-polyamide) in the paint, and to the composition of the corrosive medium (various saline solutions). This behavior is explained in terms of diffusion control through the film of zinc corrosion products around the zinc particles. The effect of these corrosion products on the coating's electrochemical activity is discussed.

INTRODUCTION

At least two fundamental protection mechanisms operate in zinc-rich coatings: a cathodic protection mechanism, which is related to the degree of electrical interconnection of the conductive particles between each other and with the steel substrate; and a barrier effect, whose action is reinforced by zinc corrosion products.[1,2] The former mechanism is related to the metallic zinc content of the coating while the latter is related to its conversion into a zinc compound.

The transformations of the zinc-rich coating during its exposure to aggressive environments are largely responsible for its ability to provide the steel base with anti-corrosion protection. These transformations mainly refer to the reaction of the zinc particles with the environment, which changes this metal to the combined state.

The percentage of zinc corroded during the cathodic protection stage of zinc-rich coatings is relatively small in comparison with the initial total zinc content. This fact, together with the relatively high cost of zinc and the desire to avoid some interferences with the welding process, has been the reason for the inclusion, for many years, of various cheaper co-pigments (extenders) in zinc-rich paint (ZRP) formulas. One of them, possibly the most common, has been a refractory conductive compound known as di-iron phosphide, Fe_2P.[3] The replacement of part of the zinc particles with conductive extender particles can obviously produce a substantial change in the transformation kinetics of the zinc particles, and hence in the behavior of the coating. This work will attempt to study this question.

EXPERIMENTAL PROCEDURE

Carbon steel samples of 10 cm × 12 cm × 0.3 cm were white metal shot-blasted, cleaned with compressed air, degreased with acetone, and dried under compressed air. The zinc-rich coatings were air-sprayed immediately afterwards to an approximate dry film thickness of 60 μm.

Different ZRP were formulated with two vehicles: ethyl silicate and epoxy-polyamide. *Table* 1 shows the paint compositions.

The samples were immersed in three solutions: 0.5% NaCl, 3% NaCl, and 0.5% $(NH_4)_2SO_4$ at approximately 20°C for varying periods of time. Chloride and sulphate ions were considered to simulate the action of the main corrosive agents in marine and industrial environments. The samples were removed from the saline baths after 5, 15, 30, and 60 days, after which they were left to dry at laboratory room temperature for three or four days. The coating was then scraped and the powder obtained was weighed. The content in metallic zinc was calculated by the gas evolution method, dissolving the zinc from the coating in hydrochloric acid and measuring the hydrogen given off.[4]

The evolution of the coating rest potential versus time was measured against a saturated calomel reference electrode (SCE).

*Avenida de Gregorio del Amo, 8, 28040 Madrid, Spain.

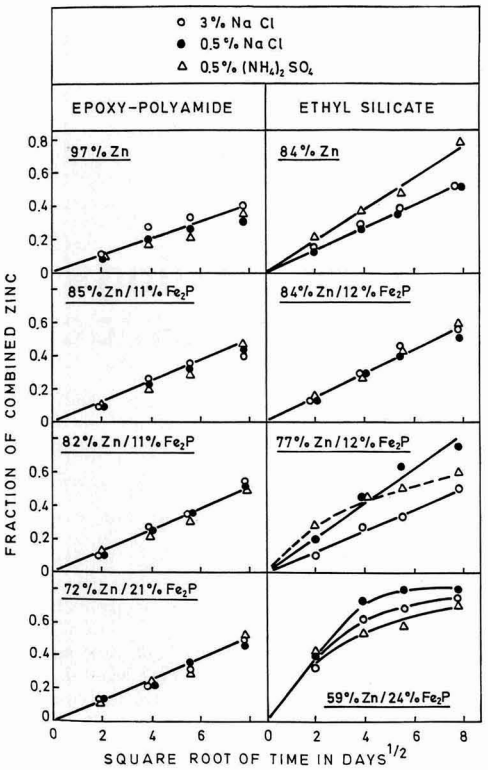

Figure 1—The fraction of combined zinc increases with time according to a roughly parabolic law

EXPERIMENTAL RESULTS

Figure 1 shows the results obtained from the different paint compositions and aggressive media tested. The salient features of these are:

(1) Attack on the zinc particles advances according to a roughly parabolic law (straight line when the fraction of combined zinc is represented versus the square root of time).

(2) The attack rate on the zinc is relatively insensitive to the change of composition of the corrosive medium.

(3) In many cases, the attack rate of the zinc particles is approximately independent of the quantity of Fe_2P in the ZRP formulation.

The ability of ZRPs containing Fe_2P extender to provide cathodic protection was studied using immersion tests. *Figure* 2 illustrates the changes in the rest potential of the coatings with time in a 3% NaCl solution. It can be seen that the time during which the high negative potentials are maintained is much longer for silicate-type coatings than for epoxy-type coatings. The same pattern was detected in a previous study with ZRPs formulated without this conductive extender.[1]

The period of cathodic protection (negative potentials over 0.8 V vs SCE) was approximately the same for the three ZRP compositions of ethyl silicate vehicle with the highest zinc contents. The cathodic protection period was less in the paint with the lower zinc content (59% Zn and 24% Fe_2P), although it was still notable. It is important to point out that in the four paints with similar total weight percentages of zinc plus Fe_2P particles (close to 85%) the possibility of cathodic protection is maintained to a large extent in spite of the amount of zinc having been replaced by Fe_2P. However, the replacement of part of the zinc by Fe_2P in epoxy-polyamide vehicle paints was accompanied by a large reduction in the period of cathodic protection (*Figure* 2).

DISCUSSION

Kinetic Attack of the Zinc Particles

Accepting that all the dissolved zinc helps to thicken the layer of corrosion products around the zinc particles, and that the diffusion resistance of this layer is directly proportional to its thickness, X:

$$\frac{dX}{dt} = \frac{K_1}{X} \qquad (1)$$

where K_1 is a constant. The integration of equation (1) gives the law of growth of the layer of corrosion products around the zinc particles:

$$X^2 = 2K_1t \qquad (2)$$

Since the amount of corroded metal, M, is proportional to K_1, the following parabolic law is obtained:

$$M = K_2t^{1/2} \qquad (3)$$

where K_2 is a new constant. The experimental fulfillment of a law of this type (*Figure* 1) suggests that the attack of the zinc in the coating is in fact determined by a diffusion process through the layer of corrosion products. The diffusion species may either be oxygen, which is consumed in the cathodic reaction, or Zn^{++} ions, which move off the anodic metal surface from which they are formed. The following argument helps to determine which of these two processes actually controls the attack of the zinc particles. The cathodic reduction of oxygen occurs primarily on Fe_2P particles forming a galvanic couple with anodic zinc particles. Therefore, if the diffusion of the oxygen was the controlling step, the rate of the process would have to depend on the quantity of Fe_2P. Given that the experimental data contradict this assumption, a logical conclusion is that the diffusion of the Zn^{++} ions through the layer of corrosion products controls the process.

The data in *Figure* 1 show surprisingly little variation between the different corrosive media used. This is easily explained provided that one accepts that the physical and chemical nature of the layer of zinc corrosion products (which control the attack) is essentially independent of the tested solution. This is probably what actually occurs, as the primary product of the corrosion in the three media is basically the same: zinc hydroxide, formed in the reaction between the Zn^{++} ions originating in the anodic

Table 1—Composition of the Zinc Rich Paints

Type of Vehicle	Components %				
Ethyl silicate	Zinc dust (by weight)	84	84	77	59
	Conductive extender, Fe_2P (by weight)	0	12	12	24
	Ethyl silicate Bentonites (antisettling agent) Solvents				
Epoxy-polyamide	Zinc dust (by weight)	97	85	82	72
	Conductive extender, Fe_2P (by weight)	0	11	11	21
	Epikote 1001 Versamid Bentonites (antisettling agent) Solvents				

process and OH^- ions which arise from the cathodic process of oxygen reduction.

An analysis of *Figure* 1 reveals that some ethyl silicate vehicle compositions formulated with higher concentrations of Fe_2P lead to abnormally high zinc corrosion rates. Accepting that the attack on the zinc is governed by diffusion through the layer of corrosion products surrounding the particles of this metal, it does not seem logical to attribute this intensification exclusively to the galvanic action between the particles of the extender and the zinc. One explanation is to relate it to a possible greater porosity of the layer of corrosion products. In this respect, as the proportion of Fe_2P increases, the cathodic reaction tends to move from the surface of the zinc particles to that of the Fe_2P particles in contact with them. This will cause the OH^- ions to react with the Zn^{++} ions away from the surface of the zinc, probably giving rise to less compact layers than if the local cathodic and anodic reactions were to occur on the same zinc particle.

Effect of Corrosion Products On the Electrochemical Activity of the Coating

According to results of Simpson and Simko,[3] the rest potential of Fe_2P in a 3% NaCl solution is about -100 mV vs SCE. The notable difference between the potential of the Fe_2P particles and that of the zinc particles (around -1100 mV vs SCE) suggests the possibility of an intense galvanic activity between both types of particles in electrical contact. In this regard, two extreme situations may be imagined: that the galvanic cell is totally polarized, or that, on the contrary, it is totally unpolarized.

The galvanic cells formed between the zinc and the Fe_2P particles are probably strongly polarized at the start of the exposure to the saline solution, especially when the silicate vehicle of less insulating properties than epoxy vehicle is used.[5] In this case, if the slope of the cathodic curve of oxygen reduction is much steeper than that of the anodic curve of zinc dissolution, the point of intersection between both curves (corresponding to the rest potential of coating) approaches the potential of the unpolarized zinc, E_A (*Figure* 3A); potentials around -1100 to -1050 mV vs SCE are typical. The steeper slope of the cathodic curve is due to the considerable retardation (high overpotential) of the cathodic process on the Fe_2P particles,[3] as well as the smaller cathode area as compared to the anode area.

With time (first in the epoxy system and later in the silicate system) the products of anodic zinc corrosion tend to block the metallic surface and to hinder the reactions of the electrode. In this circumstance, the great ohmic drop, $E'_CE'_A$ (*Figure* 3B), between the cathodic and anodic potentials will severely restrict the galvanic current. The coating potential will be between E'_C and E'_A and may be estimated bearing in mind that the potential E_M of a binary system of unpolarized electrodes is given by[6]:

$$E_M = E_A + (E_C - E_A) \frac{1}{1 + R_C/R_A} \quad (4)$$

where E_A and E_C are the potentials of the anodic and cathodic phases, respectively, and R_A and R_C are the resistances between the reference electrode and each of these phases. According to Tomashov,[6] the R_C/R_A ratio is approximately proportional to the ratio of the square roots of the anodic (f_A) and cathodic (f_C) areas. The following equation is thus verified:

$$E_M = E_A + (E_C - E_A) \frac{1}{1 + (f_A/f_C)^{1/2}} \quad (5)$$

It is evident that the measured potential under this condition will approach the potential of the phase with the greatest surface area. For example, the contents of zinc and Fe_2P in the zinc-rich paints under analysis provide an f_A/f_C ratio close to six for a paint with 77% Zn and 12% Fe_2P, and 2.5 for a paint with 60% Zn and 24% Fe_2P.

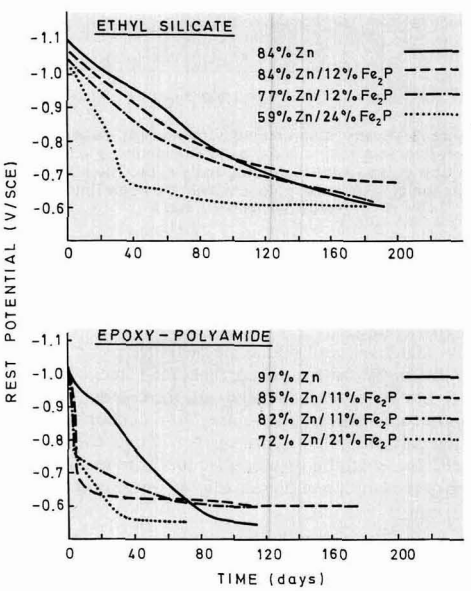

Figure 2—Evolution of rest potential with time in 3% NaCl solution

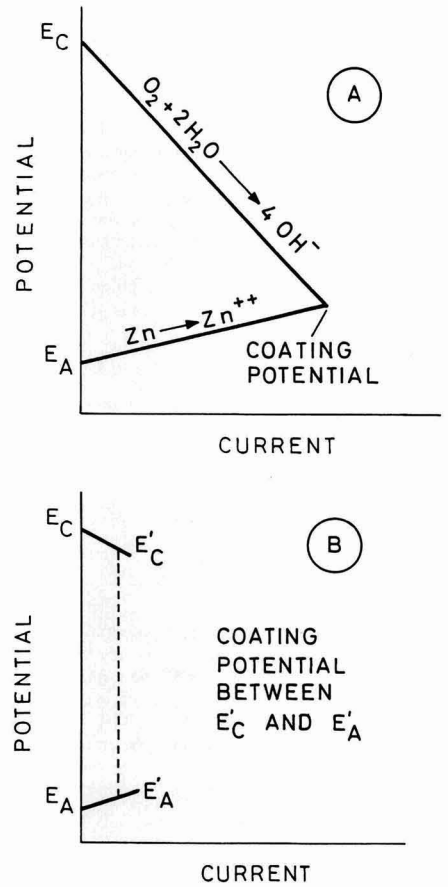

Figure 3—Evans diagrams illustrating: (A) potential of a short-circuited couple under cathodic control; and (B) potential of a couple with high ionic resistance. The couple with high ionic resistance potential will be some intermediate value between E'_C and E'_A

Applying these values, along with the values of $E_A = -1100$ mV and $E_C = -100$mV, to equation (5), coating potentials of -810mV and -713mV, respectively, are obtained.

As the quantity of remaining metallic zinc in the coating diminishes with exposure time, the values of the ratio f_A/f_C are increasingly smaller and the coating potentials thus become more noble. Hence, the reduction in activity of the galvanic cell—a consequence of both the blockage of the zinc particles by corrosion products and the reduction of the surface of these particles—results in a significant ennobling of the coating potential. This goes from initial values of near -1100 mV to values less negative than -800 mV vs SCE, which are insufficient to provide cathodic protection to the steel substrate.

In accordance with the results obtained, the galvanic couples between zinc and Fe_2P particles in the coatings formulated with the epoxy vehicle have a great tendency to behave as an unpolarized binary electrode, probably because of the low ionic conductivity of this vehicle. However, in silicate vehicle coatings, these couples tend to act as a polarized electrode, probably due to the greater current flow, which is a consequence of the relatively high ionic conductivity of the latter coatings.

CONCLUSIONS

The results suggest a diffusion control of the attack of the zinc particles in the ZRP coating. This control seems to be determined by the diffusion of the zinc ions away from the metallic surface through the layer of corrosion products. The attack rate of the zinc particles is often independent of the presence of Fe_2P in the paint.

In the ethyl silicate coatings tested, it is possible to replace part of the zinc (up to 25%) with Fe_2P with minimal decrease in the ability of the coating to provide cathodic protection to the steel substrate.

However, in the epoxy-polyamide coatings tested, the replacement of part of the zinc by Fe_2P always leads to a reduction in the ability of the coating to provide cathodic protection in comparison with the original composition without the conductive extender.

ACKNOWLEDGMENTS

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References

(1) Feliu, S., Barajas, R., Bastidas, J.M., and Morcillo, M., "Mechanism of Cathodic Protection of Zinc-Rich Paints by Electrochemical Impedance Spectroscopy. I. Galvanic Stage," JOURNAL OF COATINGS TECHNOLOGY, *61*, No. 775, 63 (1989).

(2) Feliu, S., Barajas, R., Bastidas, J.M., and Morcillo, M., "Mechanism of Cathodic Protection of Zinc-Rich Paints by Electrochemical Impedance Spectroscopy. II. Barrier Stage," JOURNAL OF COATINGS TECHNOLOGY, *61*, No. 775, 71 (1989).

(3) Simpson, V.P. and Simko, F.A., "Electrochemical Activity of Conductive Extender for Zinc Rich Coatings," *J. Oil & Colour Chemists' Assoc.*, 56, 491 (1973).

(4) International Standard ISO 3549-1976.

(5) Morcillo, M., Barajas, R., Feliu, S., and Bastidas, J.M., "An SEM Study on the Galvanic Protection of Zinc-Rich Paints," *J. Mater. Sci.*, *25*, No. 5, 2441 (1990).

(6) *Theory of Corrosion and Protection of Metals*, Tomashov, N.D. (Ed.), MacMillan Co., New York, 1966, pp 205-247.

REVIEW ARTICLE

Applications of Photoinitiated Cationic Polymerization in Coatings

James V. Crivello
Rensselaer Polytechnic Institute*

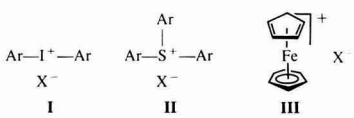
The recent development of diaryliodonium, triarylsulfonium, and ferrocenium salts as highly efficient photoinitiators for cationic polymerization has generated an entire new class of fast polymerizations which are uniquely suited for use in coating applications. This paper reviews the chemistry of the fundamental processes involved in the photolysis of the photoinitiators and mechanism of initiation of cationic polymerization. Structural modifications of the basic photoinitiator structures, which result in increased efficiency of polymerization, have been carried out. Systems based on epoxy and vinyl ether monomers were developed which are capable of generating coatings with a wide range of desirable mechanical and chemical properties.

INTRODUCTION

During the past 10 years, discoveries of compounds which efficiently initiate cationic polymerization on irradiation have made possible the development of several new commercially important technologies based on these photoinitiators. Their use in ultraviolet light (UV) curable coatings is particularly notable. One very important attractive feature is the lack of sensitivity of these polymerizations to the presence of oxygen. Consequently, there is no need to blanket coatings based on this chemistry with nitrogen. Another advantage is the use of this technology to UV cure epoxide and vinyl ether monomers and resins which brings a new dimension in properties to this field and opens substantial new markets for these materials. In addition, the very considerable direct advantages which UV curing brings to the field of coatings, namely: rapid cure speeds, pollution-free operation, and low energy consumption are retained. As a result of these attractive benefits, photoinitiated cationic polymerizations are finding important applications in areas such as coatings, adhesives, inks, and many others. Equally important has been the application of cationic photoinitiators in the microelectronics industry, especially in the area of new photoresists. This paper will report on the past, present, and future trends in the synthesis of cationic photoinitiators and cationically polymerizable monomers, as well as the many additional new applications which are currently emerging for this technology.

SYNTHESIS AND DESIGN OF CATIONIC PHOTOINITIATORS

The general structures of the three major classes of photoinitiators which have reached a considerable level of current commercial usage are:



I II III

Diaryliodonium salts, **I,** and triarylsulfonium salts, **II,** have been extensively studied in our laboratory, as well as in the research laboratories of the General Electric and 3M Companies.[1-3] The ferrocenium salts, **III,** were recently developed at the Ciba-Geigy Corporation.[4,5] Photoinitiator types **I** and **II** can be employed for all known cationically polymerizable monomers, while the ferrocenium salts, **III,** reportedly are useful only for the photoinduced ring-opening polymerization of epoxides.

Because of their current commercial importance and widespread usage, the photochemistry of the diaryliodonium and triarylsulfonium salts has received the most attention. For simplicity, the photochemistry of the diaryliodonium salts can be represented by the following two

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*Department of Chemistry, Troy, NY 12180-3590.

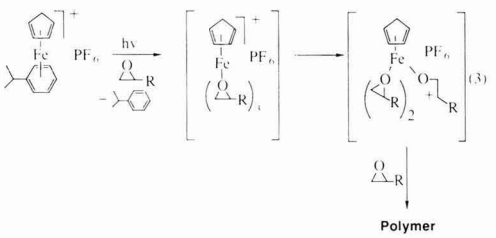
equations which show the chief photochemical processes involved.

$$Ar_2I^+ X^- \xrightarrow{h\nu} ArI: X^- + Ar\cdot \quad (1)$$

$$ArI: X^- + \text{solvent-H} \longrightarrow ArI + \text{solvent}\cdot + HX \quad (2)$$

Here, solvent-H represents a proton source; for example, the solvent or monomer. The protonic acid, HX, which is produced as a direct result of photolysis or as a byproduct of secondary reactions, is responsible for the activity of these two initiator types in cationic polymerization. Considerable insight into the understanding of the mechanism of photolysis of these compounds has been presented recently by Hacker and Decktar.[6-8] The diaryliodonium and triarylsulfonium salt classes of photoinitiators are characterized by their high photosensitivity combined with excellent thermal stability. These compounds are easily prepared from readily available starting materials and use straightforward synthetic techniques. They can be rigorously purified and readily dissolve in most typical cationically polymerizable monomers.

The mechanism proposed for the photolysis of ferrocenium salts is given in equation (3).[5]

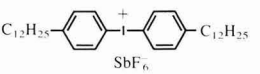


(3)

In this mechanism, photolysis of the starting ferrocenium salt results in expulsion of the aromatic ligand and simultaneously generates a coordinatively unsaturated iron complex. This complex has considerable Lewis acid character and coordinates to three molecules of the epoxide monomer. Ring-opening of the epoxide follows with the generation of a cationic species, which initiates a cationic chain reaction leading to the formation of a polymer. Ferrocenium cationic photoinitiators, while only recently available for commercial use, hold considerable potential in the UV cured coatings marketplace.

Over the past few years, a large number of diaryliodonium and triarylsulfonium compounds with wide variations in structure have been prepared. It has been found that it is possible to vary the structure of these photoinitiators within considerable latitudes, while at the same time preserving their photosensitivity. This has permitted the specific tailoring of these photoinitiators for special purposes. For example, the spectral absorption characteristics of these compounds can be manipulated by the careful introduction of appropriate chromophors to respond to virtually every portion of the UV spectrum. *Figure* 1 shows the structures of various diaryliodonium salts with their absorption maxima superimposed on the major emission bands of mercury.

Similarly, the spectral absorption characteristics of ferrocenium salts also can be readily modified by replacing the benzene or substituted benzene ligands with various polynuclear aromatic groups such as pyrene and anthracene.[5] The solubility characteristics of these photoinitiators can also be modified by appropriate substitution. For example, introduction of the long alkyl chains into the diaryliodonium salt permits its solubility in hydrocarbons and very nonpolar silicone resins.[9]



Besides directly undergoing photolysis in the presence of UV light, photoinitiators **I** and **II** can be photosensitized.[10] Both electron transfer photosensitization and triplet photosensitization have been documented. This has permitted the design of coating systems which respond to the visible region of the spectrum, as well as the UV, and which cure with incandescent light sources or even ambient sunlight.

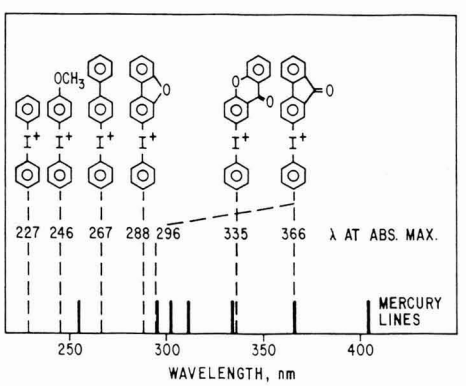


Figure 1—Superposition of absorption maxima of diaryliodonium salts on mercury lines

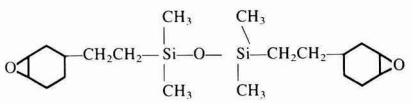
USE OF PHOTOINITIATED CATIONIC POLYMERIZATIONS IN COATINGS

Photoinitiated cationic polymerizations are especially well suited for use in UV curable coatings. The first and most practical commercially available monomers to be used with the newly discovered cationic photoinitiators were multifunctional epoxy resins. A wide variety of epoxides with differing structures suitable for UV curable "high performance" surface coating applications are available at moderate costs. A number of studies were conducted to determine the relative reactivity of these materials in photoinitiated cationic polymerization with respect to their structure. The results indicated that cycloaliphatic epoxy resins were unquestionably the most reactive. This is due not only to the high ring strain present in these monomers, but also to the lack of UV absorbing chromophors such as aromatic groups. It was further demonstrated that those onium salts which bear the least nucleophilic counterions, and therefore, gener-

ate the strongest protonic acids, give the highest rates of UV cure. In particular, those onium salts which contain the SbF_6–, AsF_6–, and PF_6– anions are especially active in epoxide ring-opening polymerizations.

The photoinitiated cationic polymerization of epoxides proceeds by a typical cationic mechanism which involves propagation by an oxygen centered cation. The most striking feature of the photoinitiated cationic polymerizations of epoxides is their ability to proceed even after irradiation has ceased. Thus, even if a coating emerges from an irradiation chamber in an incompletely cured state, polymerization will continue on standing in the dark, that is, an environment devoid of ultraviolet light, and tack-free coatings will be obtained. This "postcure" process can be accelerated by applying heat either before, during, or after the irradiation.

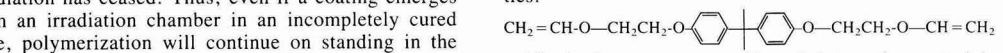
Increasing interest in epoxide-based UV curable coatings has prompted a number of investigations into means by which the rates of these polymerizations could be maximized. Besides the effective accelerating effects of heat, it was observed that the use of multifunctional alcohols as chain transfer agents had a marked positive influence on increasing the rate of UV cure.[11] In many systems, simply increasing the light intensity had a proportional increasing effect on the polymerization rate. It was also observed that it was possible to deliberately design rapidly curing epoxy resins for high speed coating purposes. For example, it was recently reported from this laboratory that cycloaliphatic epoxide functional silicone monomers and resins have 50 to 100 times greater rates of UV cure as compared to their cycloaliphatic epoxy counterparts.[12] The structure of one such epoxy-silicone monomer is shown below and is typical of a large class of di, tri, and tetra epoxy functional monomers with similar structures.



Related silicone resins bearing pendant epoxy groups have found applications in the area of rapid UV curable silicone paper release coatings.[13]

The development of stable cationic photoinitiators has made it possible to consider even more reactive monomers than epoxy resins. Work in this laboratory has focused on monomers containing polymerizable vinyl ether groups.[14,15] Although a number of aliphatic multifunctional vinyl ethers were known in the literature, they had not been employed for UV curable coatings applications. The first experiments with these monomers were quite revealing. Photoinduced cationic polymerizations occurred so rapidly that it was difficult to accurately measure their speed. Thick coatings often polymerized so vigorously that they underwent spontaneous charring. Vinyl ether-based coatings required only a fraction of the amount of the cationic photoinitiators required by comparable epoxy systems. Moreover, multifunctional vinyl ether monomers show a very low order of toxicity. The incorporation of vinyl ether groups into the design of new monomers and polymers has recently been a topic of considerable interest in the literature. Typical is the work by Lapin,[16] who showed that epoxy-terminal urethane oligomers are readily prepared and polymerized very well using cationic photoinitiators. The resulting modified urethane coatings have a wide variety of potential uses.

In our laboratories,[17,18] the design of novel classes of vinyl and propenyl ethers containing aromatic groups has been investigated. Monomers such as the one which follows, are easily prepared and display extraordinarily high rates of polymerization together with excellent properties.



Vinyl ether monomers, although interesting materials in their own right, can be used together with epoxide-containing resins to enhance the UV cure rates of these latter resins. In addition, it has been found that vinyl ethers can be used together with conventional multifunctional acrylates which cure by free radical mechanisms.[19] These "hybrid" systems show enhanced UV cure rates in air due to the reduction of oxygen inhibition effects. In such hybrid systems, one takes advantage of the ability of diaryliodonium and triarylsulfonium salts to simultaneously initiate both free radical and cationic polymerizations.

CONCLUSIONS

The development of several new classes of practical cationic photoinitiators has led to an explosion of interest in applying these materials to the design of novel UV curing coating systems. Although early systems were based on simply triphenylsulfonium and diaryliodonium salts, considerable development has led to a family of these onium salts, which have been optimized for their efficiency, spectral response, solubility, and lack of toxicity. Ongoing recent investigations have focused on the development of novel cationically polymerizable monomers and oligomers specially designed for coating applications.

Among the many additional diverse uses to which current coatings systems based on photoinitiated cationic polymerization have been applied are: clear varnishes for can coatings, leather and vinyl coatings, abrasion resistant coatings for floor tile and plastics, adhesive bonding agents for metals to glass, and photocurable staking compounds for mounting electronic components to printed circuit boards. Based on these current trends, the outlook for the future of photoinitiated cationic polymerizations in coatings applications appears very bright.

References

(1) Crivello, J.V. and Lam, J.H.W., *J. Polymer Sci.*, Symp. No. 56, 383 (1976).
(2) Crivello, J.V. and Lam, J.H.W., *Macromolecules, 10,* 1307 (1977).
(3) Watt, W.R., ACS Symp. Ser. 114, Bauer, R.S. (Ed.), Washington, D.C., 1979, p 17.
(4) Irving, E., U.S. Patent 4,482,679 (to Ciba Geigy Corporation), Nov. 13, 1984.
(5) Lohse, F. and Zweifel, H., *Adv. Polymer Sci., 78,* 62 (1986).
(6) Dektar, J.L. and Hacker, N.P., *J.C.S. Chem. Comm.*, 1591 (1987).
(7) Dektar, J.L. and Hacker, N.P., *J. Org. Chem., 53,* 1833 (1988).

(8) Hacker, N.P. and Dektar, J.L., *Polymer Mat. Sci. Eng. Preprints, 60,* 20 (1989).
(9) Eckberg, R.P. and LaRochelle, R.W., U.S. Patent 4,279,717 (to General Electric Corporation), July 21, 1981; 4,271,904 (to General Electric Corporation), Dec. 20, 1983.
(10) Crivello, J.V., *Adv. Polymer Sci., 62,* 1 (1984).
(11) Crivello, J.V., Conlon, D.A., Olson, D.R., and Webb, K.K., S.M.E. Technical Paper No FC87-247.
(12) Crivello, J.V. and Lee, J.L., *Polymer Mat. Sci. Eng., 60,* 217 (1989).
(13) Eckberg, R.P. and Riding, K.D., *Polymer Mat. Sci. Eng., 60,* 222 (1989).
(14) Crivello, J.V., Lee, J.L., and Conlon, D.A., *J. Rad. Curing.,* 10 (19), 6 (1983).
(15) Dougherty, J.A. and Vara, F.J., Proc. Radtech-North America Conf., p 372 (1988).
(16) Lapin, S.C., *Polymer Mat. Sci. Eng., 60,* 233 (1989).
(17) Crivello, J.V. and Conlon, D.A., *J. Polymer Sci., Chem. Ed., 21,* 1785 (1983).
(18) Crivello, J.V. and Conlon, D.A., *J. Polymer Sci., Chem. Ed., 22,* 2015 (1984).
(19) Crivello, J.V., Lee, J.L., and Conlon, D.A., *J. Rad. Curing, 10/1,* 6 (1983).

Society Meetings

CLEVELAND ..... OCT.

"Solvent Emission Control"

A moment of silence was observed in memory of Roger Doering, of The Glidden Company, who died recently.

Chris Clark, of Union Carbide Corp., spoke on "SOLVENT EMISSION CONTROL FOR THE FUTURE."

Mr. Clark stated that his goal was to show how supercritical carbon dioxide (CO_2) can replace solvents and therefore reduce emissions of volatile organic compounds (VOC). He described the Unicarb System, originated by Union Carbide, which is a VOC reduction technology that uses supercritical CO_2 to reduce coating solvent concentrates. He stated that CO_2 is used to reduce paint viscosity to application viscosity, to aid in atomization of the paint during application, and produce a uniform coating on the substrate.

The advantages he listed included: ease of mixing and solvating, CO_2's ability to be used with current air supply, low toxicity, nonflammability, low cost, excellent supercritical parameters and low to no odor.

According to the speaker, the Unicarb System reduces VOC emissions by 40-70%. By using slower evaporating solvents and CO_2, there is a decrease in solvent concentrations in the spray booth; this is of particular interest in hand-held applications.

The quality and performance of the final coatings is not affected by using CO_2, Mr. Clark said. He maintained that supercritical CO_2 has a phase relationship with the polymer and solvent as well as the polymers and solvents phase relationship in the system. The CO_2 interaction is influenced by composition, structure of the resin, and the pressure and temperature at which the system is operated.

The speaker also noted that when the spray patterns of the Unicarb system are compared with airless, there was better control with CO_2. He recommended that supercritical CO_2 be used as a pollution prevention technology.

Q. What type of cost comparison are we talking about with CO_2 vs solvent? Including the initial investment of your system?

A. CO_2 costs between $.05-.15 per pound vs that of the faster evaporating solvents. As far as the system goes, there is a licensing fee for the coatings company, equipment cost, and a royalty fee paid by the end user. The equipment is manufactured currently by Binks, Nordson, and Graco. As with anything else, price can be dependent on the equipment manufacturer.

ROY GLOVER, *Secretary*

KANSAS CITY ..... OCT.

"Clean Air Act"

Mary Tietjen Mindrup, of the Environmental Protection Agency, provided a presentation on "THE CLEAN AIR ACT."

Using slides to illustrate, Ms. Tietjen Mindrup discussed problems with the current Clean Air Act. She noted that it is outdated, that over 100 cities have not attained their ozone standards set by EPA, and that now acid rain has become a major consideration.

To address these problems and to strengthen current environmental laws regarding air pollution, Congress is working on a new Clean Air Act.

Ms. Tietjen Mindrup detailed the major goals which are listed under the proposed Clean Air Act: to protect public health, especially from carcinogens; to improve the quality of life; to achieve early reduction in emissions, especially in nonattainment areas; to reduce acid rain without causing an economic burden; and to employ innovative technologies.

Continuing her presentation, the speaker listed results expected from the proposed new Clean Air Act. Because they are the major ozone sources, the proposed Clean Air Act will address new regulations and set goals and projected results for motor vehicles, industrial plants, small facilities, and consumer products.

She noted that both Missouri and Kansas are committed to the implementation of these regulations, as well as the development and maintenance of VOC-controlling measures. Ms. Tietjen Mindrup predicted that this will directly affect the paint industry in these areas.

Q. In Kansas City's five county area, some counties enforce VOC regulations while others do not. For a paint company, this is unfair to some of their customers. What is being done about this?

A. The EPA admits that various areas are much more aggressive than others in enforcing regulations. As a support group to these local agencies, the EPA is trying to identify and improve such agencies. However, it must be realized that industries can still be in violation whether the local agency enforces the regulations or not.

Q. Does the state or federal government penalize offenders?

A. Both, depending on who determines the violation.

CRAIG HUGHES, *Secretary*

LOUISVILLE ..... NOV.

"Wax Emulsions"

Society President Ray Mudd, of Porter International, announced that the Society is pursuing a change in the By-Laws to allow Associate Members to hold office in the Society.

The Society will co-sponsor a symposium with Kentucky Partners on April 17, which will focus on Hazardous Waste Reduction and Solvent Alternatives.

Mary Keane and John Michelman, of Michelman, Inc., addressed the topic of "WAX EMULSIONS IN AQUEOUS POLYMERIC COATINGS: CONTRIBUTIONS AND MECHANISMS."

Ms. Keane described how incorporation of wax emulsions allows coatings to be modified without total reformulation, to modify products with little manufacturing changes, and to improve properties of the coating.

Dr. Michelman explained that the data to be presented was the culmination of two years of research. The applications discussed were wax emulsions used in acrylic latex and PVDC latex wood coatings and masonry coatings. He presented the many ways waxes may improve coatings, including lowering the coefficient of friction, antiblocking, and improved mar resistance. Other benefits are emulsifier compatibility, total solids content, and FDA acceptability.

Dr. Michelman presented the theories which explain the mechanisms by which waxes provide certain properties in aqueous coating. These theories included: the Ball Bearing Theory by which protruding wax particles provide increased slip to coatings, the Bloom Theory by which wax migrated with heat and time to the surface of the coating, and the Surface Continuity Theory which suggests that once a coating has cured that wax particles are frozen in place and only the surface particles melt and flow across the surface imparting the improved slip and other properties to the coating.

Dr. Michelman concluded by stating that wax emulsions are useful in modifying polymeric coatings to obtain good slip and antiblock properties without having to sacrifice other qualities.

TIM FORTNEY, *Secretary*

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Snyder's Willow Grove Restaurant, Linthicum, MD). JIM SMITH, Eastech Chemicals, 5700 Tacony St., Philadelphia, PA 19135.

BIRMINGHAM (First Thursday—Strathallan Hotel, Birmingham, England). D.C. MORRIS, PPG Industries (UK) Ltd., P.O. Box 359, Birmingham, B16 OAD, England.

CDIC (Second Monday—Location alternates between Columbus, Cincinnati and Dayton). ALIPIO R. RUBIN, JR., Hilton-Davis Chemical Co., 2235 Langdon Farm Rd., Cincinnati, OH 45237.

CHICAGO (First Monday—alternates between Sharko's Restaurant, Villa Park, IL, and Como Inn, Chicago, IL). WILLIAM FOTIS, Valspar Corp., 1191 S. Wheeling Rd., Wheeling, IL 60090.

CLEVELAND (Third Tuesday—Brown Derby, Independence, OH in Sept., Oct., Nov., Feb., March, April; Jan. meeting, Landerhaven, Mayfield Heights). ROY GLOVER, Mahoning Paint Corp., 653 Jones St., P.O. Box 1282, Youngstown, OH 44501.

DALLAS (Thursday following second Wednesday—The Harvey Hotel, Dallas, TX). MIKE EVANS, J.M. Huber Corp., 803 Pleasant Valley, Richardson, TX 75080.

DETROIT (Second Tuesday—meeting sites vary). SCOTT WESTERBEEK, DuPont Co., 945 Stephenson Hwy., Troy, MI 48007.

GOLDEN GATE (Monday before third Wednesday—alternates between Francesco's in Oakland, CA, and Holiday Inn in S. San Franscisco). LARRY G. SAYRE, O'Brien Corp., 450 E. Grand Ave., S. San Francisco, CA 94080.

HOUSTON (Second Wednesday—Sonny Look's Sirlion Inn, Houston, TX). TERRY F. COGAN, Raw Materials Corp., P.O. Box 690285, Houston, TX 77269.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). CRAIG HUGHES, Farmland Industries, Inc., P.O. Box 7305, N. Kansas City, MO 64116.

LOS ANGELES (Second Wednesday—Steven's Steakhouse, Commerce, CA). V.C. BUD JENKINS, Ellis Paint Co., 3150 E. Pico Blvd., Los Angeles, CA 90023.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). TIMOTHY FORTNEY, American Dispersion, Inc., P.O. Box 34033, Louisville, KY 40232.

MEXICO (Fourth Thursday—meeting sites vary). ANTONIO JUAREZ, Amercoat Mexicana, via Gustavo Baz 3999, 54030 Tlalnepantla, edo de Mexico.

MONTREAL (First Wednesday—Bill Wong's Restaurant, Montreal). ROBERTO CUBRAL, L.V. Lomas Chemical Co., 1660 Hynus, Dorval, Que., H9P 2N6, Canada.

NEW ENGLAND (Third Thursday—Sheraton Lexington Hotel, Lexington, MA). JOHN LUKENS, D.N. Lukens, Inc., 15 Old Flanders Rd., Westboro, MA 01581.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). MICHAEL FRANTZ, Daniel Products Co., 400 Claremont Ave., Jersey City, NJ 07304.

NORTHWESTERN (First Tuesday after first Monday—Jax Cafe, Minneapolis, MN). JOSEPH WIRTH, Consolidated Container Corp., 735 N. Third St., Minneapolis, MN 55401.

PACIFIC NORTHWEST (PORTLAND SECTION—Third Tuesday; SEATTLE SECTION—Third Wednesday; BRITISH COLUMBIA SECTION— Third Thursday). JOHN BARTLETT, Pacific Bartlett Co., 11813 S.E. 257th St., Kent, WA 98031.

PHILADELPHIA (Second Thursday—Williamson's Restaurant, GSB Bldg., Bala Cynwyd, PA). WILLIAM J. FABINY, Sermaguard Coatings, 155 S. Limerick Rd., Limerick, PA 19468.

PIEDMONT (Third Wednesday—Ramada Inn Airport, Greensboro, NC). ANNETTE SAUNDERS, Akzo-Reliance, P.O. Box 2124, High Point, NC 27261.

PITTSBURGH (Second Monday—Montemurro's Restaurant, Sharpsburg, PA). JEFFREY STURM, Kop-Coat, Inc., 3020 William Pitt Way, Pittsburgh, PA 15238.

ROCKY MOUNTAIN (Monday following first Wednesday—Zangs Brewery, Denver, CO). ED MCCARTHY, Cyprus Minerals, 8995 E. Nichols, Engelwood, CO 80112.

ST. LOUIS (Third Tuesday—Salad Bowl Restaurant, St. Louis, MO). DENNIS CAHILL, Archway Sales, Inc., 4321 Chouteau Ave., St. Louis, MO 63110.

SOUTHERN (GULF COAST SECTION—third Thursday; CENTRAL FLORIDA SECTION—third Thursday after first Monday; ATLANTA SECTION—third Thursday; MEMPHIS SECTION—bi-monthly on second Tuesday; and MIAMI SECTION—Tuesday prior to Central Florida Section). BILLY M. LEE, Kemira, Inc., P.O. Box 368, Savannah, GA 31402.

TORONTO (Second Monday—Cambridge Motor Hotel, Toronto). MIKE HAZEN, L.V. Lomas Ltd., 99 Summerlea Rd., Brampton, Ont., L6T 4V2, Canada.

WESTERN NEW YORK (Third Tuesday—meeting sites vary). MARKO MARKOFF, 182 Farmingdale Rd., Cheektowaga, NY 14225.

PIEDMONT ..... NOV.

"High Solids-Low VOC Alkyd Resins"

Tom Mitchell, of Hüls America, presented the Society gavel to President Gary Waters, of Sadolin Paint Products. President Waters then presented an honorarium to Past-President Forest Fleming, in recognition of his work during the past four years.

The speaker for the evening, Marvin Landau, of Hüls America, spoke on "DRIER RECOMMENDATIONS FOR HIGH SOLIDS-LOW VOC ALKYD RESIN COATINGS."

Mr. Landau reviewed the federal legislation regarding current VOC regulations. He commented that the Clean Air Act and additional regulations are changing the way that resins are manufactured and used in the industry. Due to lower VOC regulations, alkyd resins manufacturers are introducing longer oil resins, lower molecular weight resins, different polyols and oils, and changes in the manufacturing processes.

These new high solids alkyds still dry by the same mechanisms, such as solvent evaporation, oxygen absorption, peroxide formation and decomposition, and primary bond formation, he said. Just as with standard alkyds, we can use metal soaps-cobalt and manganese as oxidative driers, lead and zirconium as polymerizing driers, and calcium and zinc as auxiliary driers.

Mr. Landau explained that the recommended level of driers for alkyds used in the past can cause problems in high solids systems, for example, wrinkling, discoloration, soft films, and tackiness. Modifying formulating techniques are necessary to get the best performance for a particular resin.

Reducing the cost of driers in these new systems is also important, Mr. Landau stated. Using the higher percentage metal driers can significantly reduce cost by using less of the drier itself, as well as using less warehouse space for the customer.

Mr. Landau also discussed drier recommendations for industrial alkyds. He stressed the importance in the coatings industry today of meeting the needs of the customer.

In summary, Mr. Landau restated that low VOC alkyd resins are different from the alkyds that have been a standard in the industry, as well as being different from each other. The drier recommendations for the standard alkyds are not satisfactory. Early drier recommendations for low VOC alkyd resins were expensive and did not provide satisfactory film properties. Currently, drier recommendations are given using multimetallics to lower cost, and improve dry and film properties. Mr. Landau concluded by saying that the first generation of alkyds is being improved even now. Work between resin manufacturers and drier manufacturers on the second generation of alkyds will help solve problems in the early stages of development and in the future meet the requirements of the coatings industry.

ANNETTE SAUNDERS, *Secretary*

Future Society Meetings

Birmingham

(Mar. 7)—"Modern Dispersion Equipment for Surface Coatings"—Colin Bow, Netzsch Ltd.

(Apr. 4)—"1992: A Legislative Update for the Paint Industry"—Tony Newbold, Paintmakers Association of Great Britain.

(May 2)—62nd Annual General Meeting.

Cleveland

(Feb. 19)—"The Use of Ropaque Opaque Polymers in Architectural Coatings"—Dr. Elmer Williams, Jr., Rohm and Haas Co.

(Mar. 19)—"Choosing the Most Effective Dispersants for High Solids Coatings Systems"—Marvin Schnall, Troy Chemical Corp.

(Apr. 16)—"Coatings Characterization by Thermal Methods"—Michael Neag, The Glidden Company.

(May 21)—"Formulation of New Varnishes for Old Master Paintings"—Dr. E. Rene´ de la Rie, National Gallery of Art.

Kansas City

(Mar. 14)—"New Products from UCC"—Dave Darr, Union Carbide.

(May 10)—"Deforestation and Its Effects on our Global Environment"—Sierra Club Representative.

(June 2-3)—Joint Meeting of St. Louis/ Kansas City Societies.

Louisville

(Feb. 20)—"A Solvent Property and Solubility Parameter Calculator"—Dan King, Exxon Chemical Co.

Montreal

(Mar. 6)—"Precipitated Calcium Carbonate to Extend TiO_2"—George Green, Pfizer Minerals.

(Apr. 3)—"Modified S/B to the Rescue for Meeting VOC and Still Produce Quality Coating"—Violet L. Stevens, The Dow Chemical Co.

(May 1)—Progress Report on Technical Committee Projects—A. Brisson, Technical Committee.

New York

(Mar. 12)—"Polyurethanes in Powder Coatings for Wire and Cable"—Robert Henderson, Mobay Corp.

(Apr. 9)—Diatomaceous Silica Topics—Title to Be Announced— Sid Lauren.

(May 14)—PaVAC Night—"Low VOC Architectural Coatings"—Richard Johnson, Cargill.

Piedmont

(Mar. 20)—"New Thixotropes for High Solid Systems"—Benjamin Dent and Rudy Berndlmaier, King Industries.

(Apr. 24)—"Air Toxics"—Jim Husted, Husted & Associates, Inc.

(May 15)—"Steel Shipping Containers"—Speaker to be announced.

(June 19)—Past-Presidents' Night.

People

Dow Corning, Midland, MI, has appointed **Donald R. Weyenberg** Chief Scientist, the company's highest recognition for technical achievement. In this position, Dr. Weyenberg will coordinate Dow Corning's worldwide technology capabilities and establish alliances with leading universities, institutes, and other key external resources. He is a member of the company's Board of Directors and has directed Dow Corning's R&D efforts since 1979.

Also, **Leon D. Crossman** has been named Director of Science and Technology. Dr. Crossman's role will be to better integrate science, regardless of origin, with customer applications found in the industries served by Dow Corning. His most recent position was Director of Central Research and Development.

The shareholders of Rheometrics, Inc., Piscataway, NJ, have elected **William B. Nichols**, formerly of Hercules Incorporated, to its Board of Directors. Prior to his retirement in 1989, Dr. Nichols held several management positions in the science and technology department of Hercules' Research Center.

Paul Lozanoski has been named an Account Manager for Fitz Chem Corporation. Mr. Lozanoski will assume responsibility for the sales territory that includes accounts in Wisconsin and Minnesota.

Donald L. Brenner has been named Technical Director of the Industrial Coatings Division of Pratt & Lambert, Inc., Buffalo, NY. In this position, Mr. Brenner will be responsible for the Wichita, KS, laboratory, quality control, and quality assurance. He was previously associated with The Sherwin-Williams Company for 25 years, having served in the capacities of Chemist, Group Supervisor, Section Supervisor, and other key technical assignments.

Philip C. Bremenstuhl has joined the Ashland Chemical, Inc.'s IC&S Division as a Market Technical Specialist for paint and coatings. Based in Orange County, CA, Mr. Bremenstuhl will provide field technical service to IC&S customers in California, Washington, and Oregon. He also will be responsible for market development and other aspects of the division's expansion program for paint and coatings additives on the West Coast. Mr. Bremenstuhl is a member of the Los Angeles Society.

D.R. Weyenberg

L.D. Crossman

J. W. Maisel

J.R. Flesher

J. William (Bill) Maisel has been promoted to Applications Specialist/Sales and Marketing Department for the Chemicals Division of the J.M. Huber Corporation, Havre de Grace, MD. Prior to moving into the Sales and Marketing Department, Mr. Maisel worked in the Chemicals Division as a Research Chemist providing technical service to several industries and contributing to the product and process technology.

Ann M. Ryan has accepted the position of Manager/Analytical Chemistry for ANGUS Chemical Company/Technical Center, Northbrook, IL. In this position, Ms. Ryan will be responsible for the coordination of the Analytical Staff's work in support of new product developments as well as process development and improvement.

Roderick I.A. Watters, President of PPG Industries Asia/Pacific Ltd., in Tokyo, Japan since 1986, has been named to the new post of Vice President/Automotive Products Marketing, at PPG's Coatings and Resins Group headquarters in Pittsburgh, PA. **Richard B. Leggett**, Vice President/Chemicals, of PPG Asia/Pacific since 1986, succeeds Mr. Watters. He will spearhead the continued development and implementation of PPG's Pacific Rim regional strategy in coordination with its operating groups. **Ken Kurahashi**, who continues as Vice President/Coatings and Resins, PPG Asia/Pacific, assumes additional responsibilities as President, PPG Japan, a new post, to provide strategic leadership for further developing PPG's business interests in Japan.

In addition, **William H. Hernandez** has joined PPG Industries Inc, Pittsburgh, PA as Corporate Controller. He had been Vice President/Finance and Planning, and Chief Financial Officer of Borg-Warner Automotive for the last three years.

The naming of **Joseph R. Flesher** as Vice President and General Manager of the newly-formed UNICARB System Department has been announced by Union Carbide Solvents & Coatings Materials Division, Danbury, CT. Mr. Flesher previously held the position of Vice President and General Manager of the UCAR Emulsion System Department.

In addition, **Thomas P. Leyden** has been promoted to General Manager of OrganoSilicon Products, Systems, Services (OSi), a worldwide business group of the Specialty Chemicals Division of Union Carbide. Prior to this appointment, Mr. Leyden had been the group's Business Director.

Art Walker, of Bandholtz Paint Company, Sturgis, MI, has become the 45th President of the National Decorating Products Association (NDPA), St. Louis, MO. He previously served as Vice President and Treasurer. Mr. Walker has been a member of the organization since 1954 and has since served on its Board of Directors and on various committees and task forces. Also elected to the Board were Vice President **Norman Thomas**, and Secretary/Treasurer **Robert Perschon**. New NDPA Directors include **Roger Cooke**, **Fred Disque**, **Joel Fox**, and **Arlan Hatloe**.

In other NDPA news, **Diane Capuano** has been named Editor of *Decorating Retailer* magazine, succeeding **John Rogers** who served in that capacity for 17 years. **Tamela Adamson-McMullen**, formerly Associate Editor, succeeds Ms. Capuano as Managing Editor. The role of Associate Editor is assumed by **Susan Elliott-Smith**, who has worked as Assistant Editor for two-and-one-half years.

J. Richard "Dick" Kiefer, Jr. has announced his retirement from The Valspar Corporation, Philadelphia, PA, after 43 years in the industry.

Mr. Kiefer attended Drexel University as a co-op student from McCloskey Varnish Company from 1947-50. After earning a degree in chemical engineering, he began his career with McCloskey in areas including research and development, government specification vehicles, consumer products, customer relations, security, health and safety, and environmental and regulatory affairs.

He will continue to serve the paint industry as a member of the Board of Directors of both the Philadelphia Society for Coatings Technology and the Philadelphia Paint and Coatings Association.

Mr. Kiefer is a Past-President of the Philadelphia Society, has served on the Society Board of Directors since 1959, and received Honorary Membership status from the Society in 1989. He has been presented with the Technical Committee Award, the Liberty Bell Award, and a special Philadelphia Society Award.

Mr. Kiefer served on the Federation's Board of Directors for 12 years and served on several Federation committees: Publications, Membership (Chairman), By-Laws (Chairman), Glossary, Program, and Trigg Award (Chairman).

Schering Berlin Polymers Inc., Dublin, OH, has announced the promotions of **Alan J. Becker** to Marketing Manager/Resins and **Gaylord L. Garner** to Marketing Manager/Thermoplastics. Mr. Becker joined the company as part of the acquisition of AZS Corporation. He has been associated with the epoxy resin industry for more than 20 years. Mr. Garner has been with Schering for four years. He previously held various marketing and sales positions servicing the ink, adhesive, and resin related industries.

Morton International, Chicago, IL, has appointed **Alan F. Hume** Vice President/Adhesives and Specialty Polymers—Pacific. Mr. Hume, formerly Far East Regional Director, will be responsible for all sales and marketing of adhesives and specialty polymers in Asia in his new position. He continues to be based in Hong Kong.

The naming of two Senior Vice Presidents has been announced by Columbian Chemicals Company, Atlanta, GA. **John T. Walsh**, formerly Vice President of Sales, has been elected Senior Vice President/Marketing and Product Management. He will be responsible for worldwide marketing, production management, and sales programs in addition to sales administration.

Named Senior Vice President/Technology is **James M. Watson**, former Vice President of Research and Development. In his new position, Dr. Watson will continue to be responsible for Corporate Research and Development and will also be accountable for the technical input to all present and future licensees of Columbian Chemicals.

ARCO Chemical Company, Newtown Square, PA, has announced the retirement of **Harold A. Sorgenti**, President and Chief Executive Officer, effective June 30, 1991. He will be succeeded by **Alan R. Hirsig**, currently a Senior Vice President of ARCO Chemical and President of ARCO Chemical Europe, Maidenhead, England. The successor to Mr. Hirsig's position will be **Jack E. Oppasser**.

The Board of Directors of National Starch and Chemical Company, Bridgewater, NJ, has elected **James A. Kennedy**, President and Chief Executive Officer. Mr. Kennedy succeeds **Nicholas G. Marotta**, who has been CEO since 1985 and will continue as a member of the company's Board of Directors. Mr. Kennedy, currently Executive Vice President and Chief Operating Officer, joined National in 1962 and has held various positions in marketing, mergers and acquisitions, and international management. He was elected to the Board of Directors in 1985.

Peter Kenny has joined the staff of Liquid Carbonic Specialty Gas Corporation, Chicago, IL, as Regional Manager for the company's East Central and West Central regions. In this position, Mr. Kenny will be responsible for all of the firm's cylinder gas business in the Midwest.

A new Market Development Specialist has been named by BASF Corporation's Performance Chemicals business. **Rebecca P. Hollis**, in this position, will be responsible for the marketing of surfactants, dispersants, and polymers produced by the business.

Elections

BIRMINGHAM

Active

Evans, Terence S.—Newtown Industrial Paints, Tamworth, Staffs.
Lewis, Kevin M.—Newtown Industrial Paints, Tamworth.
Slatter, Rex A.J.—Trimite Ltd., Uxbridge, Middlesex.

Associate

Nicholson, Paul—Whitfield Chemicals, Newcastle U Lyme, Staffordshire.

CLEVELAND

Active

Glover, Roy A.—Mahoning Paint Corp., Youngstown, OH.
Kadakia, Surendra—The Glidden Co., Rocky River, OH.
McElhaney, Dean—Jamestown Paint & Varnish, Jamestown, PA.
Moon, Mary—Sherwin-Williams Co., Cleveland, OH.
Valdivia, Lorenzo A.—Sherwin-Williams Co., Cleveland.
Weidle, John H.—Sprayon Products, Div. of Sherwin-Williams Co., Bedford Heights, OH.

Associate

McNally, Thomas P.—Van Waters & Rogers, Twinsburg, OH.

Retired

Cephas, LaVada W.—Cleveland, OH.
Cervas, Benjamin B.—Middleburg Heights, OH.
Nortz, William H.—Rocky River, OH.

DETROIT

Active

Balgorsky, Michael J.—Red Spot Westland, Inc., Westland, MI.
Boyd, Eulanda A.—Standard Paint Co., Detroit, MI.
Cailloutte, Lyle A.—BASF Corp., Southfield, MI.
Houze, Eric C.—Du Pont Co., Troy, MI.
Mormile, Patrick J.—BASF Corp., Whitehouse, OH.
Richards, Bradley M.—BASF Corp., Whitehouse.
Wallace, Brent N.—BASF Corp., Whitehouse.

Associate

Ericson, Gilbert L.—Troy Chemical Corp., Newark, NJ.

Educator/Student

Coad, Eric C.—University of Michigan, Ann Arbor, MI.

GOLDEN GATE

Active

Blackburn, Roy—Flecto Co., Oakland, CA.
Cardana, David A.—Frank W. Dunne Co., Oakland.
Favata, Ted—Cal Coast Labs., Emeryville, CA.
Gill, Tejveen K.—DeSoto, Inc., Berkeley, CA.
Guanci, Dennis F.—Clearprint Paper Co., Emeryville.
Levine, Mike—L&H Paint Products, San Francisco, CA.
McConachie, William A.—O'Brien Corp., S. San Francisco, CA.
Sohrabi, Clint—Stiles Paint Mfg. Inc., Hayward, CA.

Associate

Barron, David W.—Harcros Chemicals Inc., Emeryville, CA.
Board, Charles L. Jr.—Du Pont Co., Walnut Creek, CA.
Calkin, James F.—E.T. Horn Co., La Mirada, CA.
Callen, Debra A.—E.T. Horn Co., Oakland, CA.
McCourt, Judith R.—Union Carbide, Venice, CA.
Porterfield, Kevin D.—Pfizer, Inc., Roseville, CA.
Rutledge, Melinda K.—Rheox, Inc., City of Industry, CA.

NEW YORK

Active

Andino, Ralph Jr.—Kirker Chemical Inc., Paterson, NJ.
Farer, Alan M.—Cosmair Inc., Clark, NJ.
Frankfurt, Chris C.—Cosmair Inc., Clark.
Gooney, Thomas J.—William Zinsser & Co., Somerset, NJ.
Ibrahim, Sam S.—Akzo Coatings Inc., Somerset.
Williams, Morris B.—T.J. Ronan Paint Corp., Bronx, NY.
Zapata, Luis H.—Harco Chemical Corp., Brooklyn, NY.

Associate

Baldassari, Janis—Sanncor Industries, Lodi, NJ.
Canavan, Daniel T.—D.B. Becker Co., Inc., Glen Head, NY.
Wisniewski, Ted—Drew Industrial Div., Boonton, NJ.

NORTHWESTERN

Active

Brands, Kevin J.—Cargill, Inc., Minneapolis, MN.
Frank, Martin—Valspar Corp., Minneapolis.
Hartmann, Mark H.—Cargill Inc., Minneapolis.
Hinchman, Janice L.—Cargill Inc., Minneapolis.
Johnson, Carolyn M.—Cargill Inc., Minneapolis.
Landmann, Roger D.—ChemCentral/Minnesota, Lakeville, MN.
Schiller, Robert M.—Diamond Products, Marshalltown, IA.

SOUTHERN

Active

Budzien, Brian L.—Production Finishes, Memphis, TN.
Garmon, Shane E.—Akzo Coatings Inc., Norcross, GA.
Gilliam, Robert E.—Reichhold Chemicals, Pensacola, FL.
Jackson, Inetta—Akzo Coatings Inc., Norcross.
Metro, Mark—Akzo Coatings Inc., Norcross.

Associate

Unice, Scott L.—F.R. Hall Inc., Memphis, TN.

TORONTO

Associate

Carr, David C.—Steep Rock Resources, Markham, Ont.
Demers, Normand A.—St. Lawrence Chemical Inc., Rexdale, Ont.
Murphy, John F.—Crown Cork & Seal Canada Inc., Concord, Ont.

WESTERN NEW YORK

Active

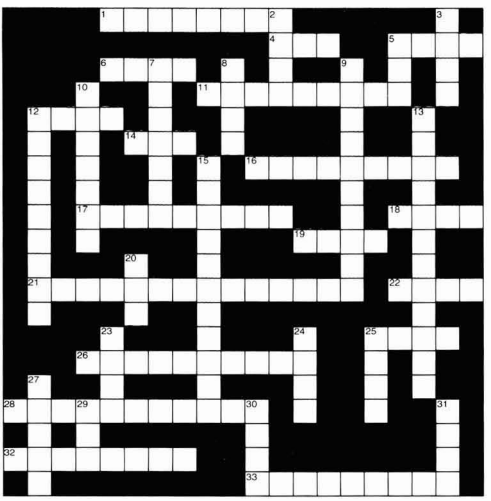
Woomer, Michael J.—Delrac Inc., Tonawanda, NY.

Associate

Zimmer, Paul L.—Zimmer Sales & Services, Rochester, NY.

CrossLinks

by Earl Hill



No. 40

Solution to be Published in March Issue

ACROSS

1. Something that colors
4. What is distortion of a wooden board?
5. Hardness test, B_____
6. Muscovite (Syn.)
11. Old name for rosin
12. To apply (verb)
14. Where the products come from
16. Marketing sells the output of 14 Across
17. Film attribute, T_____
18. A _____ of caulking
19. Structural member, transverse load bearing
21. Resistant pigment class
22. Type of adhesion test
25. Attaches to 20 Down
26. Essential oil. Used as a deodorant and mosquito repellant
28. Department frequently found between 14 Across and 16 Across
32. Being stuck together
33. Powerful, high-boiling solvent, turpentine derived

DOWN

2. Oxide used in anti-fouling paints (Abr.)
3. What is paperboard made with reclaimed paper stock called?
5. Trucks pull in here
7. Where we list all our products
8. A type of black pigment
9. What is an aggregate of colloidal droplets
10. Deep purplish red
12. Type of printing process using gelatin, C_____
13. Departing from Newtonian
15. Electrical term; 1/resistance
20. What a lid goes on top of
23. Where dispersion occurs
24. Tinge (Syn.)
25. _____ and switch advertising
27. A kind of concrete
29. Fish _____; film defect (Sing.)
30. We run these in the lab (Sing.)
31. A type of coating

Plans Underway for NACE's Corrosion/91, March 11-15 At Cincinnati Convention Center, Cincinnati, OH

Corrosion/91, the National Association for Corrosion Engineers' (NACE) international forum devoted exclusively to the protection and performance of materials, will be conducted March 11-15 at the Cincinnati Convention Center, Cincinnati, OH.

The conference will include approximately 400 technical presentations given in 35 technical symposia and numerous research presentations during the three-day "Research in Progress" symposium. In addition, more than 100 meetings are scheduled by the NACE standards-developing technical committees to discuss applied and research-oriented corrosion issues.

Many papers will be presented from the following symposia related to issues concerning the coatings and linings industries: protective coatings, special applications, and pipeline coatings. In addition, other papers will be presented on the following: refining industry; corrosion by waters; corrosion science and technology; energy technology; corrosion in petroleum production; process industries corrosion; military, aerospace, and electronics equipment corrosion control; underground corrosion control; and corrosion in the transportation industry.

The conference runs concurrently with the Materials Performance and Corrosion Show, where more that 200 exhibiting companies, in more than 26,700 net square feet of exhibit space, will display a comprehensive range of products and services.

For more details about Corrosion/91 and conference registration, contact the NACE Customer Service Dept., NACE, P.O. Box 218340, Houston, TX 77218-8340.

Dow Corning Presents $1,000 Scholarship

Dow Corning Corporation, Midland, MI has announced the presentation of a $1,000 scholarship as the result of a company-sponsored contest at the Federation's Paint Industries' Show, in Washington, D.C., in late October.

The winner, Miles T. Bryant, of The Valspar Corporation, Baltimore, MD, intends to use the scholarship for the continuing education of his son, Keith Miles Bryant, a junior at Howard University in Washington, D.C.

OCCA To Sponsor Screen Process Symposium Scheduled For March 26, in Egham, England

The Oil & Colour Chemists' Association (OCCA), Wembley, Middlesex, England, in affiliation with the Society of British Printing Ink Manufacturers and the Screen Process Technical Association, has announced the final arrangements for the "Screen Process Symposium," which will be held at the Runnymede Hotel, Egham, England, on March 26.

Nine papers will be presented at the symposium which will review developments in the screen process industry, particularly as viewed by the ink maker, stencil and equipment manufacturers.

The technical program includes: "Screen Process—Future Trends"; "Physical Chemical Aspects of the Formulation, Application, and Drying of Screen Printable Systems"; "Application of Instrumental Colour Measurement to Screen Printed Layers"; "Control of Quality in Half-Tone Printing"; "The Effects of Environmental Regulations on the Screen Process"; "Developments in Stencil Preparation"; "Textile Printing"; "Trends in Drying"; and "Why Screen?."

For further information on reservations and advance registration, contact Yvonne Waterman, OCCA, Priory House, 967 Harrow Rd., Wembley, HA0 2SF, England.

International Bridge Conference & Bridge Painting Forum Focus of SSPC Program to Be Held June 12-14

Steel Structures Painting Council (SSPC), Pittsburgh, PA, will be conducting an "International Bridge Conference: Painting Seminar," and "SSPC Bridge Paint Forum," on June 12 and June 13-14, respectively, at The Pittsburgh Hilton, Pittsburgh, PA.

The purpose of this conference and forum is to assess the effectiveness of the procedures and materials that are currently available for maximizing the service life of bridge coatings, and to explore new procedures and materials for extending coating performance. Participants will have the opportunity to become familiar with new technologies and to learn better ways to design and construct bridges for corrosion control, prepare surfaces, apply coatings, and select coating materials.

Paper topics include: "Corrosion Control and Environmental Concerns in Bridge Design and Contruction"; "Innovative Technology in Materials and Equipment"; "Performance Evaluation of Bridge Coatings"; and a tutorial on "Managing Bridge Maintenance Painting Programs."

An exhibition on bridge coating materials, equipment, and services is also scheduled.

Contact SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213-2683 for more details.

Short Course Schedule Announced by Kent State

The Chemistry Department at Kent State University (KSU), Kent, OH, has released its short course schedule for 1991. The program is part of the Cooperative and Continuing Education Program at KSU.

The program calendar includes: "Applied Rheology for Industrial Chemists"—April 22-26; "Dispersion of Pigments and Resins in Fluid Media"—May 6-10; "Adhesion Principles and Practice for Coatings and Polymer Scientists"—May 20-24; "Introduction to Coatings Technology"—October 7-10; "Accelerated and Natural Weathering Techniques for Coatings and Polymers"—October 16-18; and "Fundamentals of Chromatographic Analysis"—October 28-November 1.

For additional information, contact Carl J. Knauss, Director, Cooperative and Continuing Education, Department of Chemistry, Kent State University, Kent, OH 44242.

Literature

Rheometers

Rheometers designed specifically for measuring rheological properties of electrorheological (ER) fluids found in automotive, engineering, and aerospace applications are discussed in a data sheet. Each system includes a rheometer control console; a coaxial cylinder measuring system offering a range of field strength (kv/mm) possibilities; and a DC power supply with an "interlock" safety protection system. Contact Janet DeVita, Fisons Instruments, 24911 Avenue Stanford, Valencia, CA 91355, for more details on models VT500-ER, RV20/M5-ER, and RV20/CV20-ER.

Powder Coating Resins

Technical data sheets for a company's line of polyester-based powder coating resins have been printed. The information includes typical resin properties of each product, including color and viscosity, typical formulations, and properties of the cured and baked coatings. Write Ruco Polymer Corp., New South Rd., Hicksville, NY 11802, for more details on Rucote® Powder Coating Resins.

Paint Stripping Formulations

A technical brochure reporting how N-methylpyrrolidone (NMP) can be used as a replacement for methylene chloride in paint stripping formulations has been issued. The bulletin provides details necessary to produce five different formulations—general purpose, polyurethane, high performance, varnish and lacquer, and hot dip stripping. The efficacy of each formulation is listed. For a copy of the brochure, "Formulating Paint Strippers with N-Methylpyrrolidone," write BASF Corp., Chemical Intermediates, 100 Cherry Hill Rd., Parsippany, NJ 07054.

Solvent Systems

Comprehensive coverage of a line of solvents and specialty chemicals and how these products are used in formulating compliant high solids and waterborne coatings is given in a recently released brochure. Applications for these products include automotive, general industrial, maintenance and marine, and architectural coatings. For a copy of this brochure, write Exxon Chemical/Intermediates MAR-COM, P.O. Box 3272, Houston, TX 77023-3272.

Color Standard Collection

The introduction of a color standard collection devoted exclusively to an expanded scale of hues in the pastel range has been made through a data sheet. The book consists of color chips measuring $^{15}/_{16}$ in. X $^{5}/_{8}$ in. and mounted on 20 constant hue pages; and fan decks are made up of $1^{7}/_{8}$ in. X 8 in. solid-color swatches. Further information on the Nearly Neutrals Collection™ can be obtained by writing Munsell Color, 2441 N. Calvert St., Baltimore, MD 21218.

Micronized Wax

A six-page, four-color brochure highlighting a company's complete range of specialty micronized waxes for the ink and paint and coatings industries has been released. The bulletin gives chemical descriptions, classifications, and application suggestions for all of the firm's products. For a copy of the Micronized Wax brochure, write Micro Powders, Inc., 580 White Plains Rd., Tarrytown, NY 10591.

Acrylic Waterborne Coating

The development of a rust-inhibitive, high-build acrylic waterborne coating for direct application to steel, aluminum, concrete, and galvanizing as a primer under water-based topcoats or alone as a high performance primer/topcoat system has been announced through literature. The product is recommended for a variety of interior and exterior applications including prefinished siding, galvanized decking, storage tanks, pipe racks, and structural steel. Inquiries for additional information should be identified as "DTM Acrylic Primer/Finish," and sent to HKM Direct, 5501 Cass Ave., Cleveland, OH 44102.

Spray Painting System

A data sheet reporting on a high-volume, low-pressure (HVLP) spray painting system for automotive refinishing has been issued. The spray gun reportedly weighs 8.25 ounces, is impact resistant, is unaffected by a wide range of chemicals and solvents, and is dimensionally stable. Inquiries concerning the Atom-miser™ Spray Gun should be mailed to Dorothy Porter, Mattson Spray Equipment, Inc., 230 W. Coleman St., P.O. Box 132, Rice Lake, WI 54868.

Performance Solvents

A 12-page selection guide for the performance solvents most commonly used in coatings is now available. The booklet contains a tabular selector that matches a range of fast, medium, and slow evaporating performance solvents with their use in various types of coatings. Properties of diluents, including naphthas and aromatics, are also presented in a table. Copies of the booklet, "UCAR® Performance Solvents Selection Guide for Coatings," designated F-7465, are available from Union Carbide Chemicals and Plastics Co. Inc., Solvents and Coatings Materials Div., Dept. L4488, 39 Old Ridgebury Rd., Danbury, CT 06817-0001.

Colorimeters

The introduction of the first of a line of tristimulus colorimeters designed specifically for locations requiring multi-unit usage and color management systems has been made through a press release. Functions of the meters include data printout, statistical calculations, data output, data storage with memory backup, and automatic measurement at user selected intervals. For further details on Chroma Meters CR-300, CR-310, and CR-331, write Minolta Corp., Industrial Meter Div., 101 Williams Dr., Ramsey, NJ 07446.

Gear Pumps

Technical information has been released on two magnetic driven internal gear pumps. The pumps are designed to provide positive-displacement pumping capabilities in situations that require the highest assurance of liquid containment. Write Viking Pump, Inc., A Unit of IDEX Corp., 406 State St., Cedar Falls, IA 50613 for more details on Mag Drive.

Foam Control Agent

A defoamer which has reportedly demonstrated foam control and gloss retention in high gloss paints formulated with the latest styrene acrylic vehicles has been described in literature. The product may be suitable for other applications, such as adhesives and inks. For more details on DREWPLUS® L-435, contact Marketing Services, Drew Industrial Div., One Drew Plaza, Boonton, NJ 07005.

Technical Reports

The following technical reports reflecting a variety of international engineering practices in the field of corrosion prevention and control are now available from the National Association of Corrosion Engineers (NACE):

- "The State of the Art of Offshore Maintenance Paints (North Sea, British Sector) of Existing Systems on Fixed Offshore Structures";
- "Reviews of Current Practices for Monitoring Bacterial Growth in Oilfield Systems";
- "Selection of Test Methods for Laboratory Performance Evaluation of Sacrificial Anodes";
- "Specialized Surveys for Buried Pipelines";
- "Review of Nonconventional and Supplemental Methods for the Detection of Sulphate-Reducing Bacteria in Oilfield Waters";
- "Survey of Corrosion Monitoring Practices in North Sea, 1983"; and
- "Cathodic Protection of Steel-Reinforced Concrete."

These reports were originally prepared by a joint working group of NACE and the Institute of Corrosion (ICorr). To obtain more information about these papers, contact the NACE Customer Service Dept., NACE, P.O. Box 218340, Houston, TX 77218-8340.

Flow Modifier

A new generation flow modifier for the powder coatings industry has been introduced through a press release. The product is designed to help eliminate orange-peel finish defects, a problem that has reportedly kept manufacturers from utilizing powder coatings in situations where minor surface imperfections are not acceptable. Details on Modaflow Powder 2000 resin modifier can be obtained by contacting Monsanto Chemical Co., 800 N. Lindbergh Blvd., St. Louis, MO 63167.

Aluminum Pigments

A line of aluminum pigments designed exclusively for powder coatings is the topic of recently released literature. The series is available in a wide range of particle sizes, from coarse, high sparkle types, to very fine, high coverage grades. For more information, write Alcan-Toyo America, 1717 N. Naper Blvd., Naperville, IL 60540.

Color Specification

A color selection system featuring hundreds of the most requested interior and exterior colors is the topic of a recently released data sheet. Specifiers can select a color from a fan deck and match it to a tab divider in the accompanying compact color case. Each sample has the color name, color number, and light reflectance value listed on the back. For addition information on ColorAnswers™ (refer to SWS-3548), write The Sherwin-Williams Co., c/o Robert Silverman Co., 1375 Euclid Ave., Cleveland, OH 44115.

Paint Additive

An information kit describing the characteristics and product specifications of microcrystalline cellulose, a line of additives for paint formulations, has been released. Copies of the kit may be obtained by contacting FMC Corp., Food and Pharmaceutical Products Div., Customer Service Dept., 2000 Market St., Philadelphia, PA 19103.

Image Analysis System

A data sheet has been issued on an image analysis system for measurement and micro-analysis of plating and cladding thickness on substrates. This system reportedly can be used as a quality control tool where any substrate is plated, coated, or clad with any type of material or finish. Information on the SP-5100T Image Analysis System can be obtained by contacting Luke Hobson, Imaging Specialist, Spectra Services, Inc., 1628 Dewey Ave., Rochester, NY 14615.

Unit Conversion Facility

Literature is obtainable on a unit conversion facility which reportedly can convert values to any possible units. Over 400 predefined units and physical constants in 75 categories (acceleration, kinematic viscosity, etc.) are included. Operation is menu-driven, with online help. The system is PC/PS-2 DOS compatible and requires 640K RAM and a hard disk. Further details on the Unitran conversion facility can be had by writing Intellibase Engineering Software, Inc., 4053C Tates Creek Pk., Ste. 190, Lexington, KY 40517.

Acrylic Polyols

The introduction of two acrylic polyols for use in high solids two-component urethane coatings has been made through literature. Applications for both include high performance metal topcoats for industrial maintenance, bridges, automotive refinishing, and transportation coatings. Write S.C. Johnson Wax, Specialty Chemicals, Racine, WI 53403, for more details on Joncryl® 901 and Joncryl® 906 acrylic polyols.

Paint & Coatings Products

The availability of a bulletin detailing a company's products and services for the paint and coatings industry has been announced. Information includes particulars on a comprehensive range of solvents, performance chemicals, specialty additives and resins, and other materials needed to formulate most paints, coatings, inks, and adhesives. The brochure also describes technical services which include reformulation assistance, sample analysis, quality control, and in-plant troubleshooting. For more information, contact Ashland Chemical, P.O. Box 2219, Columbus, OH 43216, and request Bulletin #1858.

Wetting Agent

The development of a nonfoaming wetting agent designed for use in a variety of water-based systems, such as adhesives, inks, coatings, metalworking fluids, and agricultural chemicals is the subject of a recently released data sheet. The product reportedly also complies with FDA regulations 21CFR 175.105, 175.300, and 176.170, making it suitable for use in food packaging applications. For additional information on Surfynol® SE-F Surfactant, contact Air Products and Chemicals, Inc., Performance Chemicals Div., 7201 Hamilton Blvd., Allentown, PA 18195-1501.

Modified Phenoxy Resin

A 12-page booklet on a modified phenoxy resin, developed for coatings used in flexible and rigid packaging, has been published. The resin, described as a new modified phenoxy containing hydroxyl functionality, is designed to provide enhanced flexibility in addition to all the high-performance properties of conventional phenoxy resins. Copies of the booklet, "UCAR® Modified Phenoxy Resin PKHM-301 for Flexible and Rigid Packaging," designated F-60742, are available from Union Carbide Chemical and Plastics Co., Inc., UCAR Coatings Resins, Dept. L4489, 39 Old Ridgebury Rd., Danbury, CT 06817-0001.

Flash Point Testing

A four-page, four-color data sheet detailing a flash point verification instrument has been published. Specifications and characteristics are described in the literature. For information on The Rapid Tester, contact ERDCO Engineering Corp., P.O. Box 6318, 721 Custer Ave., Evanston, IL 60202.

Crosslinkers

A six-page booklet detailing crosslinkers for waterborne coatings, inks, and adhesives has been printed. The coatings are described as multifunctional carbodiimides designed for use in low-temperature crosslinkers for carboxylated polymers. Typical physical properties are listed in a table. Copies of the booklet, "UCARLINK® Crosslinkers XL-25SE and XL-27HS," designated F-60756, are available from Union Carbide Chemicals and Plastics Co., Inc., UCAR Coatings Resins, Dept. L4489, 39 Old Ridgebury Rd., Danbury, CT 06817-0001.

Activated Carbon Products

A product bulletin which catalogs over 50 types of powder, granular, and pelleted activated carbon products which are used in purification, separation, concentration, decolorization, products recovery, and catalysis applications is available. To receive a copy of "Activated Carbon Products for Liquid & Vapor Phase Applications," Bulletin No. 27-264, write Calgon Carbon Corp., P.O. Box 717, Pittsburgh, PA 15230-0717.

AC Drive

Technical literature has been released on a high-performance AC drive with features to meet the requirements of today's automated industrial environment. The unit features full-range fully automatic torque boost, speed sensorless slip control system, trip prevention functions, automatic reset restart operation, and stall prevention function. Further details on the GPD 503 AC Drive can be obtained by contacting MagneTek, 16555 W. Ryerson Rd., New Berlin, WI 53151-3511.

Underground Storage Tank

Technical information is obtainable on a composite underground storage tank (UST), which reportedly combines the structural strength and product compatibility of steel with the corrosion protection of a fiberglass laminate. The tank is available in sizes to 50,000 gallons capacity. Addition details on the Enviro-Clean composite UST are available from Clawson Tank Co., 4701 White Lake Rd., Clarkston, MI 48016-0350.

Products and Services

A catalog describing a complete line of products and services has been released. The publication provides information on product lines and distribution locations, services, company philosophy, and capabilities. To obtain a copy of the new product guide, designated Bulletin 1809, contact Ashland Chemical, Inc., P.O. Box 2219, Columbus, OH 43216.

Gloss Measurement

The introduction of bench-type glossmeter has been made through literature. The haze-gloss reportedly measures gloss at 20°, 60°, 85°, reflection haze, and mirror gloss. For additional details, contact Byk-Gardner GmbH, Lausitzer Str. 8, D-8192 Geretsried, Germany.

Trap Accessory

Literature on a solvent trap accessory designed to minimize the effects of solvent loss during rheometric testing has been released. The unit is suited for the investigation of gasoline, paints and coatings, inks, and a variety of other chemicals which readily evolve vapors. For further details, contact Fisons Instruments, 24911 Avenue Stanford, Valencia, CA 91355.

Additives

Defoamers and air release agents for high gloss, water-based coatings and solvent based, high solids paints are being highlighted in a newsletter. The brochure also includes programs on regulatory compliance, community involvement, and statistical process control. For a copy of "Drew Perspectives," write Marketing Services, Drew Industrial Div., One Drew Plaza, Boonton, NJ 07005.

Troubleshooting Guide

A troubleshooting guide and checklist for users of immersion phosphating materials and systems has been released. The four-page brochure includes a master matrix that identifies 26 problem areas sub-divided into appearance, performance, cost control, and operations categories. For information on how to obtain a copy of this guide, contact Man-Gill Chemical, 23000 St. Clair Ave., Cleveland, OH 44117.

Curatives

A product release has been issued on two oligomeric diamine curatives, that when used in two component systems, are designed to adhere to a wide variety of substrates, including steel, aluminum, polycarbonate, acrylic, ABS, and wood. Other reported applications for these curatives include their use as additives in shoe sole systems to improve abrasion and cut resistance, and in epoxies to enhance fracture toughness. Write Air Products and Chemicals, Inc., Polyurethane Chemicals Div., 7201 Hamilton Blvd., Allentown, PA 18195-1501, for further information on the POLAMINE® 650 and POLAMINE 2000 curatives.

Tank Gauging Device

A hand held portable tank gauging device, which reportedly measures the depth of liquids in containers and tanks and converts those linear measures to gallons, liters, or barrels, is the subject of a recently released data sheet. Lube oils and greases, detergents, chemicals, and diesel fuel, are a few of the products which can be inventoried by the device. For more information on the TS1100 Series Tank Shot™, contact UNISONYX, Inc., 10752 N. 89th Pl., #210, Scottsdale, AZ 85260.

Books in Print . . .

"Metallization of Polymers," edited by Edward Sacher, Jean-Jacques Pireaux, and Steven P. Kowalczyk, November 1990, 530 pp. List price: $99.95—American Chemical Society, 1155 Sixteenth St., N.W., Washington, D.C. 20036.

"1990-91 Safety & Health Catalog"—List price: Free—American National Standards Institute, 1430 Broadway, New York, NY 10018.

"Official Methods and Recommended Practices of the American Oil Chemists' Society," 4th Edition, edited by David Firestone, December 1989. List price: $350.00—American Oil Chemists' Society, 1608 Broadmoor Dr., P.O. Box 3489, Champaign, IL 61826-3489.

"Compilation of ASTM Standard Definitions," 7th Edition, 1990, 560 pp. List price: $75.00; Member price: $67.00—Philip L. Lively, ASTM, 1916 Race St., Philadelphia, PA 19103.

"Manual on Maintenance Coatings for Nuclear Power Plants," 1990, 41 pp. List price: $32.00; Member price:$25.60—Philip L. Lively, ASTM, 1916 Race St., Philadelphia, PA 19103.

"ASTM Standards for Corrosion Testing of Metals," 1990, 370 pp. List price: $51.00; Member price: $46.00—Philip L. Lively, ASTM, 1916 Race St., Philadelphia, PA 19103.

Coming Events

FEDERATION MEETINGS

For information on FSCT meetings, contact Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422 (215) 940-0777, FAX: (215) 940-0292.

1991

(May 13-17)—Federation "Spring Week." Seminar on the 13th and 14th; Board of Directors Meeting on May 15; and Society Officers Meeting on May 16. Sheraton Society Hill Hotel, Philadelphia, PA.

(Nov. 4-6)—69th Annual Meeting and 56th Paint Industries' Show. Convention Center, Toronto, Ontario, Canada.

1992

(Oct. 21-23)—70th Annual Meeting and 57th Paint Industries' Show. McCormick Place, Chicago, IL.

1993

(Oct. 27-29)—71st Annual Meeting and 58th Paint Industries' Show. World Congress Center, Atlanta, GA.

SPECIAL SOCIETY MEETINGS

1991

(Feb. 18-20)—Western Coatings Societies' 20th Biennial Symposium and Show. Hilton Hotel, San Francisco, CA. (Patricia Stull, Pacific Coast Chemicals, 2424—4th St., Berkeley, CA 94710).

(Mar. 13-15)—Dallas and Houston Societies. Southwestern Paint Convention. Dallas, TX.

(Apr. 3-6)—Southern Society Annual Meeting. The Peabody Hotel, Memphis, TN. (Vernon Sauls, McCullough & Benton, P.O. Box 272360, Tampa, FL 33688).

(May 2-4)—Pacific Northwest Society. Annual Symposium. Meridien Hotel, Vancouver, British Columbia, Canada. (John P. Berghuis, Kronos Canada, Inc., 3450 Wellington Ave., Vancouver, B.C., Canada V5R 4Y4).

(June 6)—Cleveland Society. 34th Annual Technical Conference. B.F. Goodrich R&D Center, Brecksville, OH. (Devilla Moncrief, Sherwin-Williams Co., Cleveland Technical Center, 601 Canal Rd., Cleveland, OH 44113).

(June 7-8)—Joint Meeting of the St. Louis and Kansas City Societies. Holiday Inn, Lake of the Ozarks, MO.

OTHER ORGANIZATIONS

1991

(Feb. 17-20)—14th Annual Meeting of The Adhesion Society, Bellview Biltmore Hotel, Clearwater, FL. (Howard M. Clearfield, IBM T.J. Watson Research Center, P.O. Box 218, M/S 38-145, Yorktown Heights, NY 10598).

(Feb. 17-22)—"Basic Coating Inspection." Session I of the International Coating Inspector Training and Certification Program. Sponsored by the National Association of Corrosion Engineers (NACE), Sheffield, England. (NACE Europe, P.O. Box 251, Guildford, Surrey, GU1 3DJ, United Kingdom).

(Feb. 17-22)—"Intermediate Coating Inspection." Session II of the International Coating Inspector Training and Certification Program. Sponsored by the National Association of Corrosion Engineers (NACE), Sheffield, England. (NACE Europe, P.O. Box 251, Guildford, Surrey, GU1 3DJ, United Kingdom).

(Feb. 19-22)— PDCA Annual Convention and Paint and Paper Pro Show. Sponsored by Painting and Decorating Contractors of America (PDCA). Atlanta Marriott Marquis, Atlanta, GA. (PDCA, 3913 Old Lee Highway, Ste. 33-B, Fairfax, VA 22030).

(Mar. 11-15)—62nd Introductory Short Course on the Basic Composition of Coatings. Sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Norma R. Fleming, Sr. Continuing Education Coordinator, UMR, 119 M.E. Annex, Rolla, MO 65401-0249).

(Mar. 11-15)—Corrosion/91. Sponsored by National Association of Corrosion Engineers (NACE). Cincinnati Convention Center, Cincinnati, OH. (NACE, P.O. Box 218340, Houston, TX 77218).

(Mar. 18-20)—"Polymer Blends and Alloys: Phase Behavior, Characterization, Morphology, Alloying Technology." Short course sponsored by The Institute of Materials Science, State University of New York (SUNY), New Paltz, NY. (Institute of Materials Science, SUNY, New Paltz, NY 12561).

(Mar. 18-20)—Fourth Annual Conference on Lead Paint Removal from Industrial Structures. Sponsored by Steel Structures Painting Council (SSPC). Omni Charlotte Hotel, Charlotte, NC. (Rose Mary Surgent, SSPC Meetings Manager, SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213-2683).

(Mar. 19-21)—"farbe + lack 91." The First Congress Exhibition for the Coating, Printing Inks, Adhesives, and Sealants Industry. Sponsored by *farbe + lack*. Nuremberg Exhibition Grounds, West Germany. (Klaus Geissler, Manager, Events Division, Curt R. Vincentz Verlag, Postfach 62 47, 3000 Hannover 1, West Germany).

(Mar. 25-29)—22nd Introductory Short Course on Paint Formulation. Sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Norma R. Fleming, Sr. Continuing Education Coordinator, UMR, 119 M.E. Annex, Rolla, MO 65401-0249).

(Mar. 26)—"Screen Process Symposium." Sponsored by the Society of British Printing Ink Manufacturers and the Screen Process Technicians Association. Runnymede Hotel, Egham, England. (Chris Pacey-Day, The Oil & Colour Chemists' Assoc., Priory House, 967 Harrow Rd., Wembley, Middlesex, England HA0 2SF.)

(Apr. 3-5)—Hazardous Materials Management Conference and Exhibition/Central (HazMat/Central '91). O'Hare Exposition Center, Rosemont, IL. (Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E—Ste. 408, Glen Ellyn, IL 60137-5835).

(Apr. 8-12)—Advanced Technology Short Courses on "Advanced VLSI Processing Devices and Technology." Hotel Il Ciocco, Pisa, Italy. (Tina Persson, Marketing Manager, CEI-Europe/Elsevier, P.O. Box 910, S-61225 Finspong, Sweden).

(Apr. 9-10)—"Environmental Regulations: A New Ball Game." Annual symposium sponsored by The Washington Paint Technical Group. Washington, D.C. (Mary McKnight, United States Department of Commerce, National Institute of Standards and Technology, Gaithersburg, MD 20899.)

(Apr. 13-14)—"Applications of FT-IR to Polymer Characterization." Two-day lecture and course. Atlanta, GA. (Clara D. Craver, Chemir Laboratories, 761 W. Kirkham Ave., Glendale, MO 63122).

(Apr. 15-17)— Surface Coating 1991. Sponsored by Chemical Coaters Association. Indian Lakes Resort, Bloomingdale, IL. (Chemical Coaters Assoc., P.O. Box 44275, Cincinnati, OH 45244).

(Apr. 22-25)—The Euro-Asian Interfinish Isreal 1991. Conference sponsored by the Metal Finishing Society of Isreal. Herzlia, Isreal. (Secretariat, Ortra, Ltd., 2 Kaufman St., Tel-Aviv 61500, Isreal).

(Apr. 22-26)—"Applied Rheology for Industrial Chemists." Short course sponsored by Kent State University (KSU), Kent, OH. (Carl J. Knauss, Director, Cooperative and Continuing Education, Chemistry, KSU, Kent, OH 44242).

(Apr. 25-27)—Second Annual "Surfaces '91" Trade Show. Sponsored by The Western Floor Covering Association. Las Vegas Convention Center, Las Vegas, NV. (Sheila Harman, B.P. Rice & Co., Inc., 13079 Artesia Blvd., Ste. 228, Cerritos, CA 90701-3312).

(Apr. 29-May 3)—Evaluation and Durability Conference. Co-sponsored by Steel Structures Painting Council (SSPC), Pittsburgh, PA. (SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213-2683).

(May)—ASTM Committee B-8 on Metallic and Inorganic Coatings meeting. Atlantic City, NJ. (George A. DiBari, International Nickel Co., Park 80 West—Plaza Two, Saddle Brook, NJ 07662).

(May 6-10)—"Dispersion of Pigments and Resins in Fluid Media." Short course sponsored by Kent State University (KSU), Kent, OH. (Carl J. Knauss, Director, Cooperative and Continuing Education, Chemistry, KSU, Kent, OH 44242).

(May 12-15)—AOCS 82nd Annual Meeting & Expo. Sponsored by The American Oil Chemists' Society. Chicago Marriott Hotel, Chicago, IL. (Myra Barenberg, AOCS, P.O. Box 3489, Champaign, IL 61826-3489).

(May 13-18)—"Interpretation of IR and Raman Spectroscopy Course, Lectures, and Workshops." Vanderbilt University, Nashville, TN. (Fisk Infrared Institute, Box 15, Fisk University, Nashville, TN 37203).

(May 15-17)—Sixth Annual Conference of the Architectural Spray Coaters Association (ASCA). Loews Ventana Canyon Resort, Tucson, AZ. (ASCA, 230 W. Wells St., Ste. 311, Milwaukee, WI 53203).

(May 20-24)—"Adhesion Principles and Practice for Coatings and Polymer Scientists." Short course sponsored by Kent State University (KSU), Kent, OH. (Carl J. Knauss, Director, Cooperative and Continuing Education, Chemistry, KSU, Kent, OH 44242).

(May 22-24)—"Environmental Protection, Control and Monitoring." Conference organized by the European Region of the Instrument Society of America (ISA) and co-sponsored by BAMBICA, The Association for Instrumentation, Control and Automation Industry in the U.K., and The Institute of Measurement Control in the U.K. Birmingham, England. (ISA, 67 Alexander Dr., P.O. Box 12277, Research Triangle Park, NC 27709).

(May 29-31)—Fourth International Symposium on Polymer Analysis and Characterization; June 1-2—Short course "Major Polymer Characterization Techniques and Methods." Baltimore Inner Harbor, MD. (Judith A. Watson, Professional Association Management, 750 Audubon, East Lansing, MI 48823).

(June 3-7)—22nd Annual Short Course on "Advances in Emulsion Polymerization and Latex Technology." Sponsored by Lehigh University, Bethlehem, PA. (Mohamed S. El-Aasser, Emulsion Polymers Institute, Lehigh University, 111 Research Dr., Bethlehem, PA 18015).

(June 5-7)—5th International Conference on Crosslinked Polymers. Sponsored by State University of New York (SUNY). Luzern, Switzerland. (Angelos V. Patsis, Institute in Materials Science, SUNY, New Paltz, NY 12561).

(June 10-14)—"High Solids and Low-VOC Coatings." Short course sponsored by North Dakota State University (NDSU), Fargo, ND. (NDSU Continuing Education, P.O. Box 5819, University Station, Fargo, ND 58105-5819).

(June 12-14)—International Bridge Conference: Painting Seminar on the 12th. Administered by Steel Structures Painting Council (SSPC) and sponsored by the Engineers Society of Western Pennsylvania. SSPC Bridge Painting Forum on the 13th and 14th. Sponsored by SSPC. The Pittsburgh Hilton, Pittsburgh, PA. (SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213-2683).

(June 12-14)—SURCON '91, "Developments in the Science of Surface Coatings." Moat House International Hotel, Stratford-upon-Avon, England. (Simon Lawrence, CIBA-GEIGY Pigments, Hawkhead Rd., Paisley, Renfrewshire PA2 7BG, Scotland).

(June 17-28)—"Coatings Science." Short course sponsored by North Dakota State University (NDSU), Fargo, ND. (NDSU Continuing Education, P.O. Box 9, University Station, Fargo, ND 58105-5819).

(June 19-21)—First International Symposium on Environmental Effects on Advanced Materials. Sponsored by National Association of Corrosion Engineers (NACE). Catamaran Resort Hotel, San Di-

ego, CA. (NACE Customer Service Dept., P.O. Box 218340, Houston, TX 77218).

(July 7-12)—Seventh International Conference on Surface and Colloid Science (ICSCS). Sponsored by the International Association of Colloid and Interface Scientists, Université de Technologie de Compiègne, France. (M. Clausse, Secretariat of the 7th ICSCS, c/o Wagons-Lits Tourisme, B.P. 244, 92307 Levallois-Perret Cedex, France).

(July 8-12)—17th International Conference in Organic Coatings Science and Technology. Sponsored by State University of New York (SUNY). Athens, Greece. (Angelos V. Patsis, Institute in Materials Science, SUNY, New Paltz, NY 12561).

(July 17-19)—Introductory Short Course on "Basic Coatings for Sales and Marketing Personnel." Sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Norma Fleming, Sr. Continuing Education Coordinator, UMR, 119 M.E. Annex, Rolla, MO 65401-0249).

(Sept. 3-5)—2nd International Paint Congress. Sponsored by The Brazilian Association of Paint Manufacturers (ABRAFATI). Anhembi Convention Centre, São Paulo, Brazil. (Específica S/C Ltd., Rua Augusta, 2516—2nd Floor, Ste. 22, 01412, São Paulo, SP, Brazil).

(Sept. 9-13)—63rd Introductory Short Course on "The Basic Composition of Coatings." Sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Norma Fleming, Sr. Continuing Education Coordinator, UMR, 119 M.E. Annex, Rolla, MO 65401-0249).

(Sept. 10-12)—North American Hazardous Materials Management Conference and Exhibition. Sponsored by *HazMat World* magazine. Cobo Hall, Detroit, MI. (Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E, Ste. 408, Glen Ellyn, IL 60137).

(Sept. 24-26)—The Polyurethanes World Congress 1991. Co-sponsored by the European Isocyanate Producers Association and the Polyurethane Division of The Society of Plastics Industry (SPI), Inc. of the USA. Acropolis Arts & Convention Center, Nice, France. (Fran Lichtenberg, Polyurethane Div., SPI, 355 Lexington Ave., New York, NY 10017).

(Sept. 29-Oct. 2)—RADTECH Europe '91 Conference and Exhibition. Edinburgh Exhibition and Trade Centre, Edinburgh, Scotland. (Exhibit Manager, RADTECH 91, c/o FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey, RH1 1QS, United Kingdom or Conference Secretary, RADTECH '91, c/o PRA, Waldegrave Rd., Teddington, Middlesex, TW11 8LD, England).

(October)—ASTM Committee B-8 on Metallic and Inorganic Coatings meeting. Philadelphia, PA. (George A. DiBari, International Nickel Co., Park 80 West—Plaza Two, Saddle Brook, NJ 07662).

(Oct. 2-4)—Hazardous Materials Management Conference and Exhibition/South (HazMat/South). Sponsored by *HazMat World* magazine. Georgia World Congress Center, Atlanta, GA. (Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E, Ste. 408, Glen Ellyn, IL 60137-5835).

(Oct. 7-10)—"Introduction to Coatings Technology." Short course sponsored by Kent State University (KSU), Kent, OH. (Carl J. Knauss, Director, Cooperative and Continuing Education, Chemistry, KSU, Kent, OH 44242).

(Oct. 9-11)—"Verbundwerk '91." 3rd International Trade Fair on Composite Technology, Reinforced Plastics, Metals, and Ceramics. Rhein-Main-Halls, Wiesbaden, Germany. (Diana Schnabel, DEMAT, Postbox 110 611, 6000 Frankfurt 11, Germany).

(Oct. 16-18)—"Accelerated and Natural Weathering Techniques for Coatings and Polymers." Short course sponsored by Kent State University (KSU), Kent, OH. (Carl J. Knauss, Director, Cooperative and Continuing Education, Chemistry, KSU, Kent, OH 44242).

(Oct. 21-25)—23rd Introductory Short Course on "Paint Formulation." Sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Norma Fleming, Sr. Continuing Education Coordinator, UMR, 119 M.E. Annex, Rolla, MO 65401-0249).

(Oct. 28-Nov. 1)—"Fundamentals of Chromatographic Analysis." Short course sponsored by Kent State University (KSU), Kent, OH. (Carl J. Knauss, Director, Cooperative and Continuing Education, Chemistry, KSU, Kent, OH 44242).

(Nov. 4-5)—"Electrochemical Impedance: Analysis and Interpretation." Symposium sponsored by ASTM Committee G-1 on Corrosion of Metals. San Diego, CA. (John R. Scully, Sandia National Labs., Org. 1834, P.O. Box 5800, Albuquerque, NM 87185).

(Nov. 6-8)—POWDEX. Organized by Cahners Exhibition Group. Georgia World Congress Center, Atlanta, GA. (Angela Piermarini, Show Manager, Cahners Exposition Group, 1350 E. Touhy Ave., P.O. Box 5060, Des Plaines, IL 60017-5060).

(Nov. 8-12)—1991 International Surface Finishing & Coatings Exhibition (SF China '91) and the 1991 International PC Board Making & Electro-Chemicals Exhibition (PCB China '91). Shanghai Exhibition Center, Shanghai, P.R. China. (Sinostar International Ltd., 10A Harvest Moon House, 337-339 Nathan Rd., Kowloon, Hong Kong).

1992

(Feb. 23-26)—Williamsburg Conference, "Comparison of Color Images Presented in Different Media." Co-sponsored by the Inter-Society Color Council and the Technical Association of Graphic Arts, Colonial Williamsburg, VA. (Milton Pearson, RIT Research Corp., 75 Highpower Rd., Rochester, NY 14623).

(Oct. 25-30)—Fourth Corrosion and Protection Iberoamerican Congress and First Panamerican Congress on Corrosion and Protection. Mar del Plata, Argentina. (CIDEPINT, 52 entre 121 y 122, 1900 La Plata, Argentina, South America).

Advertisers Index

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'Humbug' from Hillman

Recently and happily retired, Dick Kiefer took time out from his new fun activities to send us the following from Rotary's "Stripped Gears" (slightly altered).

A Guide to Committee Jargon

My committee has decided . . . I managed to chat with a member just before the meeting.

The committee met and evaluated the situation . . . half the members showed up and chatted for a while.

A great deal of additional work will be necessary before the proposal can be acted on . . . no one understood it.

The matter is being considered . . . let's wait until a member brings it up again.

I will report on the matter more fully at the next meeting . . . I forgot that I should have done something about it before today.

The results were inconclusive . . . nothing was accomplished.

While no agreement was reached, definite progress was made toward resolving differences . . . nobody budged an inch.

It is suggested that the wisest course . . . this is what I think.

It is widely accepted that . . . one other person agrees with me.

Therefore the consensus is . . . and a couple of others think so, too.

With the greatest respect . . . I wonder what gives you the idea that you are capable of giving me any advice.

There are some key issues here that must be addressed . . . I haven't a clue what this job is all about.

This concludes the committee's appraisal of the situation . . . we absolve ourselves of future responsibility.

It is hoped that this report will stimulate increased interest in the problem . . . let someone else do it next time.

At the height of his fame, John Barrymore went into a Hollywood haberdashery and bought some shirts and ties. "Charge it as usual," said Barrymore.

"The name is?" asked the clerk.

"Barrymore."

"The first name?"

The great Barrymore was furious.

"Ethel," he replied.

* * *

The politician was mangling the facts during his political tirade. "He's murdering the truth," said one newsperson to another.

"Don't worry," the reporter replied. "He'll never get close enough to do any harm."

* * *

A heckler accused a candidate of being two-faced. Without hesitation or change of expression, he calmly replied, "I leave this to the audience. If I had two faces, would I be wearing this one?"

* * *

Good executives never put off until tomorrow what they can get someone else to do today.

* * *

Why didn't Noah just swat both flies?

—The Lion

—People call it take home pay because there's no other place you can afford to go with it.

—Middle age is when the torso becomes more so.

—Old census takers never die. They just get to where they don't count anymore.

—Did you ever get the uncomfortable feeling that perhaps your gray hair isn't premature?

—Inflation is when everybody is so rich that no one can afford anything.

—Sign in a tatoo parlor: "Tatooing while you wait."

—One of the pleasures of age is looking back on the girls you didn't wed.

—1969 Farmers' Almanac

More from the "Little Pun Book" so unkindly sent to me by John Warner, for the sadists in our midst:

—A girl once told an eager fingered piano player to keep his dissonance.

—In baseball-mad Chicago, a man tried to teach his wife German. He asked, "Was sagst du?" She replied, "They lost 7-1."

—A nuclear physicist is reported to have too many ions in the fire.

—The farmer named his rooster Robinson because he Crusoe.

—A Mexican girl said to another that she had the handsomest husband in Mexico. "No he isn't," said the other, "you should have seen the Juan that got away."

. . . . In those days people did not live as long as they do today, but things lived longer. In our house old things were not discarded but retired to a drawer in the kitchen which we called "Mama's shame-to-throw-out-drawer." Every family had one. It contained at all times such indispensibles as half a pair of scissors, a toothless comb, eyeglass frames without lenses, empty vaseline jars, a black button marked "off," a key to the old apartment, and a "gold" medal which read "Best wishes Thom McAn Shoes."

—Sam Levenson

—Herb Hillman
Humbug's Nest
P.O. Box 135
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Coatings Application	Desired Performance Qualities	PTFE Product
Container, solvents	can mobility and spin-neck abrasion resistance	SST-3D
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Ultra-thin clears	abrasion resistance with clarity retention	FluoroLUBE-A
Coil, protective	corrosion inhibition and falling sand resistance	SST-2SP5
Coil, decorative	taber abrasion and metal-mark resistance	FluoroSLIP 515
Powder coating	durability	FluoroSLIP 525
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